Scope of Work

EPA Region 5 Records Ctr.

TION 1

Remedial Investigation/ Feasibility Study

Crab Orchard National Wildlife Refuge

U.S. Fish and Wildlife Service
U.S. Department of interior
Marion, Illinois
and
Sangamo-Westor, Inc.
Atlanta, Georgia

April 1985





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April 19, 1985

U.S. ENVIRONMENTAL PROTECTION AGENCY 230 South Dearborn Street Chicago, Illinois 64604

Attn: David M. Taliaferro, Esq.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY 2200 Churchill Road Springfield, Illinois 62706

Attn: Mr. Robert Cowles

Superfund Coordinator

Re: Remedial Investigation/

Feasibility Study Crab Orchard National

Wildlife Refuge

File: 3114.001

Gentlemen:

In accordance with a schedule agreed upon at our meeting in Chicago on March 29, 1985, we are submitting the attached draft Scope of Work for the RI/FS to be conducted at the Crab Orchard National Wildlife Refuge in Marion, Illinois. Please provide your review and approval, subject to any comments you may have, within two weeks as agreed upon at the March 29 meeting.

This draft Scope of Work is a result of a number of activities which have occurred during the past several months:

- An initial draft Scope of Work was transmitted to this Office by the U.S. Department of Interior on December 12, 1984 which followed an initial site visit on November 14, 1984.

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- This initial draft Scope of Work was reviewed and discussed during a Technical Review meeting at U.S. EPA offices in Chicago on January 18, 1985. At that meeting, a comprehensive review of all available data was also presented which served as background for the development of a solid Scope of Work. Concurrence was attained during that meeting relative to the general RI/FS approach and a number of technical issues in the proposed sampling and analysis plan for the Area 9 and Lake sampling programs.
- Subsequent to a site visit for Area 9 on February 7, 1985, the Area 9 sampling and analysis schedule was further refined and the status presented at our meeting of February 21 in Springfield, Illinois.
- Another site visit was conducted during the period of March 26 through March 28, 1985 to prepare the sampling and analysis schedules for the remaining study areas around the refuge. Personnel from O'Brien & Gere were accompanied by Dick Ruelle and other Fish & Wildlife Service personnel from the refuge during that visit.

This draft Scope of Work represents a great deal of effort on the part of the Department of Interior, Sangamo Weston, Inc. and our staff. It is an unusually detailed product which will more easily facilitate the production of a comprehensive RI/FS Work Plan.

Flease don't hesitate to contact Cornelius B. Murphy, Jr. or Steven R. Garver (315-451-4700) of this office if we can provide clarification or be of assistance.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

C.B. Murphy Ju.

Cornelius B. Murphy, Jr., Ph.D. Senior Vice President

CBM:djb

Attachment:

cc: Primary Contacts List (Appendix I)
Christian E. Liipfert, Esq.
John N. Hanson, Esq.
Paul Shorb, Esq.
Alison Ling

SCOPE OF WORK REMEDIAL INVESTIGATION/FEASIBILITY STUDY CRAB ORCHARD NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF INTERIOR
MARION, ILLINOIS

AND

SANGAMO-WESTON, INC.
ATLANTA, GEORGIA

O'BRIEN & GERE ENGINEERS, INC. 1304 BUCKLEY ROAD SYRACUSE, NEW YORK 13221

APRIL 1985

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INTRODUCTION

There are two parts to this Scope of Work, one for the Remedia Investigation and one for the Feasibility Study (RI/FS) which are related to contaminant investigations on certain portions of Crab Orchard National Wildlife Refuge ("the refuge") or ("NWR"). The portions of the refuge which will be addressed by this RI/FS are listed in Table 1 and their geographic locations are shown on Figure 1. A background on each of these sites is provided in Appendix III.

The refuge is administered by the U.S. Fish and Wildlife Service (FWS) of the Department of the Interior. A list of principal contacts that can provide additional information about the sites is included in Appendix I. The contractor's Remedial Investigations Report(s) will be divided into two parts: 1) the current status of contaminated sites on the refuge and 2) costs necessary for studies to complete an evaluation of contaminated sites on the refuge.

The contractor should be prepared to provide his own temporary office space on the refuge as needed. The location of this facility will be coordinated with the Refuge Manager. The contractor will be responsible for controlling access to the sites during the time they are conducting their studies. The contractor and any subcontractors will be required to perform analyses on spiked and blank samples for QA/QC purpose prior initiation of the sampling and analysis program.

TABLE 1

CRAB ORCHARD REFUGE

SAMPLING SITES

Site #	<u>Type</u>	<u>Name</u>
3	Landfill	Area 11 South Landfill
14.	Landfill*	Area 11 North Landfill
5	Pond	Area 11 Acid Pond
7	Surface Water	D Area SE Drainage
7A	Surface Soil	D Area North Lawn
8	Surface Water	D Area SW Drainage
9	Surface Water	P Area NW Drainage
10	Surface Water	Waterworks North Drainage
11	Surface Water	P Area SE Drainage
11A	Surface Soil	P Area North
12	Landfill*	Area 14 Change House Site
13 14	Surface Soil Surface Water	Area 14 Change House Site
15	Pond	Area 14 Solvent Storage
16	Surface Soil	Area 7 Plating Pond Area 7 Industrial Site
17	Landfill	
18	Surface Soil	Job Corps Landfill Area 13 Loading Platform
19	Surface Soil	Area 13 Bunker 1-3
20	Surface Water	D Area South
21	Landfill	Southeast Corner Field
22	Surface Water	Old Refuge Shop
24	Surface Water	Pepsi-West
25	Surface Water	COC at Marion Landfill
26	Surface Water	COC bellow Marion STP
27	Surface Water	COC below 157 Dredge Area
28	Landfill	Water Tower Landfill
29	Landfill	Fire Station Landfill
30	Control*	Munition Control Site
31	Control*	Refuge Control Site
32	Landfill	Area 9 Landfill
3 3	Surface Soil	Area 9 Building Complex
34	Lake	Crab Orchard Lake

STATEMENT OF WORK

PART I - REMEDIAL INVESTIGATIONS

The purpose of this remedial investigation is to determine the nature and extent of any contaminant problem at several sites (Table 1 and Figure 1) on the Crab Orchard National Wildlife Refuge and gather all data necessary to support the feasibility study. The contractor shall furnish all personnel, materials and services necessary for or incidental to performing the remedial investigation on the Crab Orchard National Wildlife Refuge.

The remedial investigation consists of eight tasks:

Task 1 - Description of Current Situation

Task 2 - Investigation Support

Task 3 - Site Investigation

Task 4 - Preliminary Remedial Technologies

Task 5 - Site Investigations Analyses

Task 6 - Final Report

Task 7 - Community Relations

Task 8 - Additional Requirements

TASK 1 - DESCRIPTION OF CURRENT SITUATION

The contractor shall describe the background information pertinent to the sites and outline the purpose and need for remedial investigations at that location. The data gathered during any previous investigations or inspections and other relevant data should be used. A

summary of published and unpublished data available on Crab Orchard Creek watershed and Crab Orchard Lake is included in Table 1 of Appendix II. This information shall be incorporated into Task 6.

A. Site Background

Prepare a summary of the regional location, pertinent area boundary features, surface area, and general site physiography, hydrology, and geology of the sites. The general nature of any contaminant problems, including pertinent history relative to the use of the sites for waste disposal, should be defined.

To complete this task, it will be necessary to: 1) contact various agencies by telephone and 2) assume that one preliminary information-gathering trip will have to be made to Illinois Environmental Protection Agency-Springfield, and Marion, Illinois to confer with Illinois EPA, and local well drillers, to Crab Orchard National Wildlife Refuge to confer with the Fish and Wildlife Service and to Champaign, Illinois to confer with U.S. Geological Survey, and the Soil Conservation Service.

B. Nature and Extent of Problem

Prepare a summary of the actual and potential on-site and off-site health, and environmental effects, if any, based on current knowledge of the contaminated sites. This may include, but is not limited to the type, physical states, and

amounts of the substances involved; the existence and conditions of drums, landfills, and disposal areas; affected media and pathways and exposure; contaminated releases such as leachate or runoffs; and any human exposure.

C. History of Response Actions

Prepare a summary of any previous response actions conducted by either local, State, Federal or private parties, including the site inspections, other technical reports, and their results. The scope of the RI/FS should be developed to address the problems and questions that have been identified during previous work at the sites.

TASK 2 - REMEDIAL INVESTIGATION SUPPORT

The contractor shall conduct the following preliminary work necessary to conduct the site investigations and feasibility studies.

A. Site Visit

Conduct initial site visits to become familiar with site topography, access routes, and proximity of receptors to possible contamination, and collect data for preparation of the site safety plan. The contractor shall conduct site surveys to identify and stake boundaries of known contaminated areas, monitoring wells, and soil borings, and to identify sediment sample locations. A geophysicist also shall evaluate the applicability of using geophysical methods to determine the existence of contaminant groundwater plumes if necessary.

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Cost estimate should assume one trip for two people. Since no site safety plan has been developed, surveys will have to be completed off-site with the aid of aerial photos or maps. The visit should be used to verify the site information developed in Task 1.

B. Site Maps

Prepare site maps showing all wetlands, water features, drainage patterns, tanks, buildings, utilities, paved areas, easements, right-of-ways, and other features. The site maps and all topographic surveys shall be of sufficient detail and accuracy to locate and report all existing and future work performed at the sites. Areas to be investigated should be mapped, preferably using existing topographic maps or aerial photos. The topographic maps shall be prepared with 1-foot contours referenced to the National Geodetic Vertical Datum with a scale of 1 inch to 50 feet. The maps shall extend 200 feet beyond site boundaries and include all drainages to Crab Orchard Lake.

Establish boundary lines encompassing contaminanted areas. The boundary lines for the study sites can be identified using seismographic methods, magnetometer methods and other acceptable methods. Landfill surface boundaries will be staked for identification. The boundary conditions should be set so that subsequent investigations will cover the contaminated media in sufficient detail to support the feasibility study. The boundary conditions may also be used

to identify boundaries for site access control and site security. If necessary, a fence or other security measures may be installed as an initial remedial measure.

C. Dispose of On-Site Generated Waste

All wastes generated by on-site activities shall be drummed and stored within the fenced areas. Wastes which will be drummed include: all drill cuttings, all purged groundwater from well development, decontamination wash water and disposable protective clothing. These materials will be disposed of during cleanup actions. to be to the first the factorial strong.

TASK 3 - SITE INVESTIGATIONS

The contractor shall conduct remedial investigations necessary to characterize the site and its actual or potential hazard to public health and the environment. The site investigations should generate data of adequate technical content to support detailed evaluations of alternatives during the feasibility studies.

The site investigations will be conducted in two phases. Phase I will provide a screening of each site to analyze composited samples for a broad array of potential contaminants. Geophysical surveys and installation of groundwater monitor wells is also included in Phase I. Phase II will consist of an assessment of the extent of contamination at each site where materials of concern are found. The sites listed in Table 1 fall under four categories.

Line.

- 1. Landfills
- 2. Surficial Contaminant Sites
- 3. Streams
- 4. Ponds
- 5. Lake

In addition, two control sites will be included for sampling and analyses. The general rationale employed in developing the sampling and analysis schedules for each category of sites is shown in Table 2. The specific detail for each site is included in Appendix III.

All sample analyses will be conducted in accordance with U.S. EPA protocols, or methods specified by the U.S. Fish and Wildlife Service. Strict chain-of-custody procedures will be followed and all sample collection locations or grids will be identified on the site maps established under Task 2.

A. Geophysical Surveys

The purpose of the geophysical investigations shall be to determine the extent of soil and groundwater contamination, if any, in the vicinity of several specified study sites as outlined in Appendix III. The investigations shall consist of magnetometer and electromagnetic induction (EM) surveys. Initially, test surveys shall be conducted to determine the applicability of the method before proceeding with a full scale The instrument shall provide shallow surveying survey. capabilities up to а maximum depth of 25 feet.

TABLE 2

REMEDIAL INVESTIGATION SAMPLING & ANALYSIS SEQUENCE

Site Category	Recon.	<u>Phase I</u>	Phase II	Contingency
Landfills	Geophysics	Cores - depth composites - full pps & expl. + ICP metals - Install wells-anal. indicators + metals.	Radial & depth cores Anal. wells for pp's & expl. found in cores & AA metals.	
Surface	Geophysics -locate utilities	Surf. Soils - full pps & expl. + ICP metals.	Depth soils) AA Radial soils - surf. & depth) metals Runoff - water & sediments &) depth profile)	Wells
Streams				
- Waters		Upstream/downstream - full pp's & expl.		
- Sediments		Surf. seds: 2 near shore, 1 near lake - full pps + expl. + ICP	Surf. seds - int + depth seds pps found + AA metals	
Ponds				
- Waters		(Same rationale as streams)		
- Sediments - Groundwater		(Same rationale as streams) Upgr/dngr wells (2) - indicators	Depth profile on sediments pp's + expl. found in waters or seds.	Additional wells
Lake				
- Waters		5 sites: primary & secondary - DW stds.	5 biota sites + 5 use sites: anything found in Phase I	
- Sediments		(None)	5 sites: parameters found in Phase !	
- Biota		Sample & freeze	parameters found in Phase I	
Control Sites				
- Lake control		Full scans		
- Soil & gw control				
- Clean area				
- Munitions area				

Technical memoranda describing the geophysical investigations with interpretations shall be prepared and submitted to the Fish and Wildlife Service before proceeding with the hydrogeologic investigations. The actual areas to be studied is undetermined but will need to be determined and identified in the RI/FS work plan.

B. Hydrogeologic Investigations

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Develop and conduct a program to determine the present and potential extent of groundwater contamination, if any, and evaluate the suitability of the site for on-site waste containment. Efforts should begin with a survey of previous hydrogeologic studies and other existing data (completed as part of Task 1 a and c). The survey should address the degree of hazard, the mobility of chemicals considered, the soil attenuation capacity and mechanisms, discharge/recharge areas, regional flow direction and quality, and effects of any pumping alternative. Subsequent to the survey of existing data, sampling programs should be developed to determine the horizontal and vertical distribution of chemicals considered and predict the long-term disposition of such chemicals. The sampling program should, at a minimum, evaluate factors affecting groundwater performance, background levels of contamination, the type of well construction utilized, the number and location of wells, chain-of-custody, record of samples, and the groundwater sampling method.

Monitoring wells may be necessary. If so, they will be constructed of 2-inch I.D. Schedule 40, threaded, flush-point PVC pipe with a 5- to 10-foot long, PVC slotted screen or equivalent materials constructed of stainless steel. Each well will be covered with a vented, PVC cap and the pipe will be protected with a 4-inch I.D., locked, protective steel casing, set in a concrete pad. Well screens will be packed with a coarse sand from the bottom of the screen to 6 inches above the screen. Above the course sand pack, a 2-foot bentonite seal (using either granular bentonite or bentonite pellets) will fill the annular space between the soils and the casing. The remaining annular space will be grouted to the ground surface with a tremie pipe to assure that the grout is forced to the bottom and fills all voids. Wells will be developed until no water is contaminant free fines are present. If wells are clean, in the expert opinion reduced & State main officials of the hydrologist and free of contaminants, additional wells will not be required. All monitoring wells will be constructed in accordance with State and local agency regulations.

After all wells are installed, the top of the outer, 4-inch casing will be surveyed relative to the National Geodetic Vertical Datum using a benchmark set for the preparation of the site topographic map. The survey record will note the elevation of the top of the inner casing, as well as the distance from the top of the inner casing to the top of the protective casing with the lid open.

Static water levels will be measured in each well by a hydrogeologist or geologist to the nearest 0.01-foot from the top of the 2-inch well casing. All measurements necessary to prepare maps of potentiometric surfaces or water tables will be taken on the same day to avoid variation in hydrologic conditions over time. Wells will be allowed to recover at least one week after well installation before static water levels are measured.

A total of 21 groundwater monitor wells are specified in Appendix III. It should be assumed that a driller can be procured from within 150 miles of the site.

C. Sampling and Analyses of Groundwater

Before water sampling begins, the cap will be removed and the well will be monitored immediately for volatile organic compounds. As water is being evacuated, monitoring will continue to assure that proper respiratory protection is being worn as necessary and to identify (qualitatively) contaminated groundwater locations.

Wells will be evacuated prior to sampling. The amount of water evacuated from each well will equal at least five times the amount of standing water in the well casing. Evacuation will continue until no fines are present. If the wells recover slowly and go dry before five well volumes can be purged, a sample will be collected on the following day after recovery. Samples will be obtained with a stainless steel bailer and will be transferred carefully from the bailer

to acid-cleaned bottles to avoid turbulence. All wells will be sampled twice during the RI; at least one week after well completion, and again during Phase II sampling. All water evacuated during well development will be drummed and stored onsite until the RI is completed.

All groundwater samples will be collected, preserved, labeled and shipped in accordance with the Quality Assurance Project Plan. Samples will be analyzed for the following parameters in the field:

Temperature

рΗ

Specific Conductance

The cost estimate for this task includes sampling of wells previously installed at the refuse, in addition to the proposed new monitoring wells specified in Appendix III. Prior to installing additional monitoring wells, the three existing on-site wells will be sampled and the water will be analyzed for priority pollutants. Then, based on the geophysical results (Task 3a) and results of contaminant analyses, the extent and scope of any hydrogeologic investigation shall be determined.

D. Soil Investigation

Develop and conduct a program to identify the location and extent of surface and subsurface soil and sediment contamination. This process may overlap with certain aspects of the hydrogeologic study, e.g., characteristics of soil strata

are relevant to both the transport of contaminants by groundwater and to the location of contaminants in the soil. An additional number of soil borings will be collected from various sampling sites around the refuge. The locations where these samples are to be collected and sampling handling protocols are defined in Appendix III for the various potentially contaminated sites, suspected of containing contaminant

E. Surface Water and Sediment Investigation

Develop and conduct a program to determine the extent pedimentary that water sediment, musles pands, adjuning inhast of contamination of Crab Orchard Lake. This process may in relevant refused on overlap with the soil investigation; data from lake sediments sampled may be relevant to surface water quality. A survey of existing data on surface water quality and quantity may be a useful first step. The locations where samples are to be collected and sample handling protocols are defined in Appendix III.

F. Fish and Wildlife Investigations

other aquatic organisms Selected species of fish and wildlife on the refuge will be collected and analyzed for residual levels of contaminants landfills previously identified in dumps and other contaminated areas to be collected, on the refuge. The species, number of organisms, collection locations and analytic procedures are identified in Appendix III, Site 34.

TASK 4 - PRELIMINARY REMEDIAL TECHNOLOGIES

A. Post-Investigation Evaluation

contractor will assess the investigation results and recommend preliminary remedial technologies best suited to site problems.

They will provide the basis for developing detailed alternatives and the cost effective analyses during feasibility studies. The work during the remedial investigations will generally be limited to the following:

Either during or following the site investigations the

- 1. Recommending types of remedial technologies appropriate the physical and contaminant to site conditions.
- Recommending whether or not to remove some or all of the waste for off-site treatment, storage, or disposal.
- 3. Determining the compatibility of groups of wastes with other wastes and with materials considered as part of potential remedial action (e.g., sturry walls, lagoon liners). Recommending alternatives for treatment, storage, or disposal for each category of compatible waste.

TASK 5 - SITE INVESTIGATIONS ANALYSIS

The contractor shall prepare a thorough analysis and summary of all site investigations and their results. The objective of this task will be to ensure that the investigation data are sufficient in quality and quantity to support the feasibility studies.

The results and data from all site investigations must be organized and presented logically so that the relationships between site investigations for each medium are apparent.

A. Data Analysis and Endangerment Assessment

Analyze all site investigation data and develop a summary of the type and extent of contamination at the sites. The summary should describe the quantities and concentrations of a specific chemical at the site and ambient levels surrounding the site. The Refuge Manager, Crab Orchard NWR will assist in the selection of a control site for the collections of ambient samples. Prepare an endangerment assessment describing the present and future contaminant threat to public health or the environment.

The analysis should discuss the degree to which either source control or off-site measures are required to significantly eliminate the threat, if any, to public health or the environment. If the results of the investigation indicate that no threat or potential threat exists, a recommendation of no remedial response should be made.

TASK 6 - FINAL REPORT <

The contractor shall prepare a final report covering the remedial investigation phase and distribute ten copies to the FWS. The report shall include the results of Tasks 1 through 5. The report shall be structured to enable the reader to cross-reference with ease. (See introduction for items to be addressed.)

The Community Relations Program is included as Jack 7, however,

TASK 7 - COMMUNITY RELATIONS

The dissemination of information to the public on this project will -throughout the duration of the project. be coordinated by the Service, 'The contractor will be required to provide personnel, at the Service's discretion, to support the programs as community relations must be integrated closely for all remedial re-1) Keep the community infrined as the state progressio, sponse activities.

The objectives of this effort are to achieve community understandmout and support a ing of the actions taken and to obtain community input and support

- 7. Changes in personnel
- 8. The monthly progress report will also list target and actual completion dates for each element of activity including project completion and provide an explanation of $any_{\Lambda}deviation$ from the milestones in the work plan schedule.

- 9. Copies of information provided in Items 1 through 8 shall be submitted to FWS.
- 10. A Work Plan that includes a detailed technical approach and schedules shall be submitted for the proposed feasibility study (see Appendix V).

В.

Safety Plan -> Contraduction to what's on Prior to conducting any field activities the contractor shall develop a site health and safety plan to protect the health and safety of personnel involved in the remedial investigation. The plan will be consistent with:

Section 111(c)(6) of CERCLA.

EPA Order 1440.3 - Respirator Protection

EPA Order 1440.2 - Health and safety requirements for employees engaged in field activities.

EPA Occupational Health and Safety Manual.

Other EPA guidance as provided.

State Safety and health statutes.

Site conditions.

EPA Interim Standard Operating Safety Guide (September 1982) and applicable OSHA standards.

C. Quality Assurance/Quality Control (QA/QC)

This plan shall be submitted to the FWS for approval. The contractor shall prepare and submit 30 days prior to conducting any field activities a Quality Assurance Project Plan (QAPP) for the sampling, analysis, and data handling

aspects of the remedial investigation. The QAPP plan shall be consistent with U.S. Fish and Wildlife Service, State and Federal EPA requirements. The plan shall address the following points.

- QA Objectives for Measurement Data, in terms of precision, accuracy, completeness, representativeness and comparability.
- 2. Sampling Procedures.
- 3. Sample Custody. Any field sample collection and analyses shall be documented in accordance with chain-of-custody procedures as provided by IEPA, USEPA, and the FWS. These procedures will include: 1) keeping samples located in a safe place after collection and prior to shipment to the analytical laboratory; 2) completing chain-of-custody forms before shipping samples, sealing samples with evidence tape prior to shipment and 4) completion of the chain-of-custody form by the receiving laboratory.
- 4. Calibration Procedures, References and Frequency, of Field Equipment.
- 5. Internal QC Checks and Frequency. QC Procedure.
- 6. QA Performance Audits, System Audits, and Frequency.
- 7. QA Reports to Management.
- 8. Preventative Maintenance Procedures and Schedule.

- 9. Specific Procedures to be used to routinely assess data precision, representativeness, comparability, accuracy, and completeness of specific measurement parameters involved. This section will be required for all QA project plans.
- 10. Corrective Action.
- Site Specific Sampling Plans for all media (soil, sedi-11. A soil sampling program ments, and water samples). Samples should be developed and conducted to identify the horizontal and vertical distribution of contaminated soils on the sites being evaluated. Information regarding sample location local background levels, degree of hazard, and sample collection locations shall be included. utilized and methods of analyses should be included. See Appendix III for sampling locations.

Soil, sediment, and water sampling protocols should be developed and conducted to identify the degree of hazard. The protocols should include information on local background levels, location and frequency of samples, sampling techniques and methods of analyses on areas of known and suspected contamination on the refuge. A sampling program should be developed to identify contaminant levels in selected species of fish and wildlife. Recommended lists of species, their collection locations and methods for their collection, preservation and handling are identified in Appendix III. The sampling

in the Appendix

numbering, and constituents for analyses for each sample as described in the appendices. An approved selection of samples collected at specified areas of each contaminated site shall be analyzed as described in Appendix III. The pH and cation exchange capacity shall be determined for all sampled soils, where specified. Based on preliminary results, the parameters to be analyzed or the number of samples remaining to be analyzed may be reduced if approved by USEPA and FWS. The sampling plans shall describe the sampling and analyses techniques appropriate to site conditions.

The camples will be collected and shandled in accordance with the analysis to be performed upon them.

The sampling protocol should discuss potential incompatibility of wastes. Wastes should be analyzed and grouped into compatibility classes. This classification should support any subsequent conclusions about segregating wastes on-site and developing preliminary remedial alternatives. The QA/QC Plan shall conform to the guidelines in the Users Guide to the USEPA's "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" (QAMS-005/80).

12. Establishment of policy pertaining to good laboratory practices and related documentation of experimental procedures, personnel training, and instrument calibration for measuring PCDD and PCDF residues for certain specified sites.

Should be written out in descriping what these symbols stand for.

A quality assurance unit within the testing facility will be designated by the contractor who is charged with the responsibility for assuring that the facilities, equipment, personnel, methods, practices, procedures, records and controls are designed and function in conformance with good laboratory practice regulations and the protocols for individual laboratory studies as listed in the Federal Register Vol. 48, No. 230. The quality assurance unit is required to inspect periodically each phase of the study and to document the inspection. Written reports shall give the status of the study. The problems noted, and the actions taken to resolve the problems are required to be submitted to management and FWS, Project Officer. For each investigation phase, the quality assurance unit is required to perform an evaluation of the study to detect errors in recording data, lack of conformity to the appropriate protocol, and deviations from good laboratory practice and standard operating procedures. A master schedule sheet of all studies conducted at the testing facility shall be maintained showing the current status of each study.

Sampling

The purpose of sampling is to provide samples representative of the environment under study, on a scale that enables the sample to be handled in the laboratory. Analytical results are meaningful only if collected samples are representative and they satisfy the goals of the monitoring study or research program. The sites, techniques, and frequency of sampling and the size and number of samples will be determined in accordance with the statistical design of the proposed investigation.

Sample Custody

All samples will be taken by chemists, physical science tech
collected for unalysis

nicians, or other qualified personnel designated by the contractor

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with specific instructions from the project supervisor. All samples

clupical paryles with the ratio of 100 for the purposes of GC

for residue analysis will be placed in the custody of the analytical

information

chemist responsible for the analysis. The samples will be recorded

on the sample report sheets if analyzed immediately. Stored

samples (including archive portions) will be catalogued and frozen

hand of sample storage may

be audited by the QA Officer.

Calibration Procedures, References, and Frequency

A. General

Standards may be generally grouped into two classifications, primary and secondary. Primary standards include USP and NF drugs, NBS and ASTM materials, and certain designated EPA reference materials. All other standards are to be considered secondary.

B. Testing

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- Primary: No testing is necessary. Do not use if there
 is any physical indication of contamination or decomposition (i.e. partially discolored, etc.).
- 2. Secondary: Examine when first received either by comparison to an existing primary, or comparing known physical properties to literature values. The less stable standards will be rechecked at appropriate intervals, usually six months to one year.

C. Storage

- 1. All standards will be stored in appropriate locked areas.
- All special storage requirements (i.e. refrigeration, storage under nitrogen, etc.) will be met.

D. Records

- A records book will be maintained for each grouping of standards (i.e. pesticides, metals, etc.).
- 2. The record kept for each standard will include:
 - a. Name and date received
 - b. Source
 - c. Code or lot number
 - d. Purity
 - e. Testing data including all raw work and calculations
 - f. Special storage requirements
 - g. Storage location
- These records will be checked periodically as part of the Laboratory Controls Review.

Equipment

H 1

A. General

- Each major piece of analytical laboratory instrumentation used on this project shall be documented.
- 2. A form will be prepared for each new purchase and old forms will be discarded when the instrument is replaced.

B. Testing

- Each form details both preventative maintenance activities and the required QA testing and monitoring.
- In the event the instrument does not perform within the limits specified on the monitoring form, the responsible supervisor will be notified and a decision made as to what action to take.
- If repair is deemed necessary, an "out of order" sign will be placed on the instrument until repairs are effected.

C. Records

- A bound notebook will be kept with each instrument to record all activities related to maintenance, QA monitoring, and repairs.
- These records will be checked during periodic equipment review.

EQUIPMENT QA MONITORING

(example form)

<u>Instrument</u>: Gas Chromatograph/Mass Spectrometer

Manufacturer:

Model:

Accessories:

Ionization Modes:

Electron impact, chemical ionization with both positive and negative ion detection.

Preventative Maintenance:

Clean and service if instrument parameters cannot be adjusted to give a 3X signal to noise ratio for an injection of 40 picograms of 2, 3, 7, 8-TCDD.

Name Supervisory Personnel: Date inspected:

Data Reduction, Validation and Reporting for PCDFs and PCDDs

The electron impact mode (EI) and multiple ion detection (MID) are used for GC/MS identification and quantitation of PCDFs and PCDDs including isotopic marker compounds (e.g. 13 C-TCDD and 37 CI-TCDF. Series of either eight of twelve mass-to-charge ratio (m/z) values are monitored within each of five or six chromatographic windows, each window being defined by the lower and upper elution limits of a particular group of PCDF and PCDD congeners. The MID analysis involves the monitoring of four to five members of a molecular ion cluster and, when possible, of the fragment ion cluster resulting from the loss of COC1, M-63.

Quantitation Procedures

Quantitations of 2, 3, 7, 8-TCDD, 2, 3, 7, 8-TCDF, and OCDD are made directly by comparison of the integrated responses of the native compounds with those of representative isotopically enriched marker compound. The concentrations of these substances are calculated using the following equation:

An = Ai (Rn/RI)C

An = concentration of native compound

Al = concentration of isotopic marker compound

Rn = integrated response of native compound

RI = integrated response of isotopic marker compound

C = relative response correction factor

The correction factor, C, is determined by analysis of a mixture of known amounts of isotopic marker compound and an authentic sample of the native material under those GC/MS conditions used in analysis of samples. The data resulting from residue analyses will be forwarded to the Project Officer through the chemist's supervisor and the QA Officer. Other QA data from biological and chemical water quality analyses also will be forwarded in a similar manner.

QA Monitoring

Daily or as used - Inject PCDD and/or PCDF standards and compare RRT and responses as per protocol.

Analytical Procedures

The most sensitive and routinely employed determinative procehigh-resolution dures for **PCDF** and **PCDD** residues are gas chromatography (HRGC)/low resolution mass spectrometry (LRMS) and less frequently with HRGC/HRMS. Under the requirements of a limit of detection of 3 pg/g in tissue and 100 pg/g in soil for 2, 3, 7, 8-TCDD and TCDF, multiple ion monitoring (MIM) procedure during GC/MS analysis is necessary for attainment of maximum instrumental sensitivity. Unfortunately, the gain in sensitivity is accompanied by a reduction in analytical specificity; only limited portions of the fragmentation pattern of a compound can be observed. The reduced specificity exacerbates the potential for specific interference and false positive determinations. The required analytical method and sensitivity will be selected on the basis of regulatory action levels or concentrations which may pose an environmental problem, as agreed upon by FWS, USEPA and the contractor.

Analyses for PCDF and PCDD residues in the contractor's laboratory shall include the determination of the members of 10 congener groups

(tetra- through octachloro) of the PCDF and PCDD and of two or three isotopically enriched marker compounds. Four to six individual masses of the molecular ion cluster are monitored for each congener group. For example, in the GC window containing tetrachlorodibenzofurans (tetra-CDF) and tetrachlorodibenzo-p-dioxins (tetra-CDD) the following masses are monitored: 304, 306, 308, and 310 for tetra-CDF; 320, 322, 324 and 326 for tetra-CDD, 312 for 37 C1-tetra-CDF (marker compound), and 332, 334 and 336 for 13 C-tetra-CDD (marker compound).

Routinely, aliquots of the analyte equivalent to a 5- to 20-g portion of the sample are injected for the HRGC/LRMS-MIM analysis in the electron impact (EI) ionization mode. This corresponds to 50-200 pg of a component present as 10 ppt. Instrumental limits of detection for individual components range 10-30 pg in the MIM mode, compared to approximately 1 ng for full-scan analysis. The prerequisites to be adopted at the laboratory for the confirmation by HRGC/LRMS-MIM of a particular PCDF or PCDD isomer are:

1. signal-to-noise ratio of 3;

- correct and unique relative retention time (within 2 parts in 1000) compared with an authentic sample (in some cases determined on two different liquid phases);
- correct nominal molecular mass; and
- correct chlorine isotope abundance ratios for four to six members of the molecular ion cluster.

Internal Quality Control Checks
Spiked and processed blanks

A series of appropriate spike samples (concentrations to bracket in accordance with U.S. EPA requirements) observed levels) and process blanks will be analyzed with each set of

twenty

ten samples. Additionally, an appropriate standard solution is analyzed after every tenth sample and if determined to be outside established control limits, the samples will be reanalyzed.

QA Performance Audits, System Audits, and Frequency
The Contractor will disagnate a QA officier and provide five with his
A performance audit, consisting of analysis of appropriate blanks, I her name fortified samples and standard solutions will be performed quarterly for Continette and will inform the FWS the duration of the project. The AQA Officer will maintain a record of such audits and will inform the Project Officer of significant deviations from established control limits. These audits will test not only the total system's response, but inherently all major measurement methods.

QA Reports to Management

O'Briefrate these people. The QA Officer will report to the Project Supervisor and Project Officer the results of assessment of; the accuracy, precision and completeness of the data, results of the performance and system audits, and any problems encountered in the analytical procedures. The QA Officer, in conjunction with the analyst, analyst's supervisor, and Project Supervisor will formulate recommendations to correct any deficiency in the analytical protocol or data. These corrective measures must be in accord with ongoing good laboratory practices and the overall Quality Assurance Program.

Preventive Maintenance Procedures and Schedule

See Equipment QA Monitoring

All inspection activities and maintenance will be conducted by a chemist(s) qualified (either by training or experience) to perform these operations. All repairs, adjustments or required calibrations will be documented in the appropriate log book.

Specific Procedures for Assessment of Data

The data will be reviewed by the QA officer, analysts, supervisory chemist, and project officer to insure accuracy and precision. Procedures to rectify problems identified in these reviews will be formulated and completed before data are considered acceptable. This procedure is required due to the absence of "standard" protocols for assessment of data involving PCDD and PCDF residues.

Corrective Action

See QA Report to management.

Check Samples

The FWS shall provide samples of soil containing known amounts of PCBs, PCDFs and PCDDs or priority pollutants to the contractor. These samples will serve as Quality Assurance Samples. Quality Control Samples shall constitute approximately 1 in 20 samples from Area 9. The contractor will advise the FWS of the analytical results promptly and FWS contract officer shall advise the contractor if remedial action is required.

Just John Turk

GLP for PCBs and Other Priority Pollutants

The contractof shall provide QA/QC documentation equivalent to these specified for 2, 3, 7, 8-TCDD and TCDF for the proposed analysis of polychlorinated biphenyls (PCBs) and other priority pollutant residues in soils Asediments and other matrices as required by the FWS.

Methodology to be utilized shall be equivalent to the methodology accepted as best available technology for analysis of the EPA Priority Pollutants.

The methodology shall be in accordance with the tast F. P. Priority Pollutants.

PART II - FEASIBILITY STUDIES

Purpose

The purpose of the remedial action feasibility studies is to develop and evaluate remedial alternatives, and to identify the cost-effective remedial action to be taken at contaminated sites on the refuge. The contractor shall furnish the necessary personnel, materials, and services required to prepare the remedial action feasibility study, except as otherwise specified herein.

Scope

The feasibility study consists of eight tasks numbered 9 through 16:

Task 9 -- Description of Proposed Response

Task 10 -- Development of Alternatives

Task 11 -- Initial Screening of Alternatives

Task 12 -- Laboratory Studies

Task 13 -- Evaluation of the Alternatives

Task 14 -- Final Report

Task 15 -- Conceptual Design

Task 16 -- Additional Requirements

TASK 9 - DESCRIPTION OF CURRENT SITUATION AND PROPOSED RESPONSE

Information on the site background, the nature and extent of the problems and previous response activities presented in Task 1 of the remedial investigation may be incorporated by reference.

Following this summary of the current situation, site specific statements of response purpose, based on the results of remedial investigations, should be presented. The statement of purpose should be organized in terms of components amenable to discrete remedial measures (e.g., a statement of purpose describing the evaluation of alternatives for treatment of any affected groundwater).

TASK 10 - DEVELOPMENT OF ALTERNATIVES

Based on the results of the remedial investigations and consideration of preliminary remedial technologies (Task 4), the contractor shall develop a limited number of alternatives for source control or off-site remedial actions, or both, on the basis of objectives established for the response and the scoping decisions for site clean up. The number of alternatives may vary for each site; however, a minimum of three should be proposed for each site since the first alternative to consider would be to not relocate the contaminated material (no-action alternative).

A. Establishment of Remedial Response Objectives

Establish site-specific objectives for the response.

These objectives shall be based on threats, if any, to public health and the environment determined through information gathered during the remedial investigation, Section 300.68 of the National Contingency Plan (NCP), USEPA interim guidance, and consultation and with FWS. Preliminary clean-up objectives shall be developed in consultation with the FWS.

B. Identification of Remedial Alternatives

Develop alternatives to incorporate remedial technologies (from Task 4b), response objectives, and other appropriate considerations into a comprehensive, site-specific approach. Alternatives should include non-clean up (e.g., relocation) and no-action options. The alternatives shall be developed in close consultation with the FWS.

TASK 11 - INITIAL SCREENING OF ALTERNATIVES

The alternatives developed in Task 10 will be screened by the contractor and FWS to eliminate alternatives that are clearly not feasible or appropriate, prior to undertaking detailed evaluations of the remaining alternatives. Screening should be completed within 60 days of receiving the alternatives.

Considerations to be Used in Initial Screening

Three broad considerations must be used as a basis for the <u>initial</u> screening: I cost, 2 effects of the alternative, and acceptable engineering practices. More specifically, the following factors must be considered:

 Cost. An alternative whose cost far exceeds that of other alternatives, and yet achieves only a marginal increase in effectiveness, usually will be eliminated. Total cost will include the cost of implementing the alternative and the cost of operation and maintenance.

- 2. <u>Environmental Effects</u>. Alternatives posing significant adverse environmental effects will be excluded.
- 3. Environmental Protection. Only those alternatives that satisfy the response objectives and contribute substantially to the protection of public health or the environment shall be considered further. Source control and off-site alternatives shall minimize or mitigate the threat of harm to public health or the environment.
- 4. Implementability and Reliability. Alternatives that may prove excessively difficult to implement, will not achieve the remedial objectives in a reasonable time period, or rely on unproven technology will be eliminated.

TASK 12 - LABORATORY STUDIES (if required)

The contractor shall conduct any necessary laboratory and bench scale treatability studies required to evaluate the effectiveness of remedial technologies and establish engineering criteria (e.g., leachate treatment, groundwater treatment; compatability of waste/leachate with site barrier walls, cover, and other materials proposed for use in the remedy). It is expected that the scope of this task will depend on the results of Tasks 10 and 11 and therefore will not be complete at the start of Task 13. The Contractor will submit a separate work plan for any proposed laboratory studies for FWS approval. This submittal will be made in the time frame required to maintain steady progress of the

overall feasibility study. (Additional studies also may be conducted during the design phase if needed to refine treatability results or develop detailed design criteria.)

TASK 13 - EVALUATION OF THE ALTERNATIVES

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The contractor shall evaluate the alternative remedies that pass through the initial screening in Task 11, and recommend the most cost effective alternative to the Service.

Alternative evaluation shall be preceded by a detailed developed of remaining alternatives.

A. <u>Detailed Development of Remaining Alternatives</u> Alternatives developed must meet the applicable requirements of all environmental statutes.

The detailed development of the remaining feasible remedial alternatives shall include as a minimum:

- Description of appropriate treatment and disposal technologies.
- Special engineering considerations required to implement the alternative (e.g., pilot treatment facility, additional studies needed to proceed with final remedial design).
- Environmental impacts and proposed methods, and costs, for mitigating any adverse effects.
- Operation, maintenance, and monitoring requirements of the remedy.
- 5. Off-site disposal needs and transportation plans.
- 6. Temporary storage requirements.

- Safety requirements for remedial implementation (including both on-site and off-site health and safety considerations).
- 8. A description of how the alternatives could be phased into individual operable units. The description should include a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement to the environment or savings in costs.
- A description of how the alternative could be segmented into areas to allow implementation of differing phases of the alternative.
- 10. A review of any disposal facilities to ensure compliance with applicable requirements and other environmental laws.

After alternatives have been identified, and two weeks had her had her after her notice given, a public hearing will be held. Written comments from government agencies and individuals on the alternatives will be accepted for three weeks following the hearing.

B. Environmental Assessment

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Perform an Environmental Assessment (EA) for each alternative. The EA shall include, at a minimum, an evaluation of each alternative's environmental effects, an analysis

of measures to mitigate adverse effects, physical or legal constraints, and compliance with CERCLA or other regulatory requirements.

In addition, each alternative will be assessed in terms of the extent to which it mitigates long-term exposure to any residual chemical substance and protects public health both during and after completion of the remedial action, assessment shall describe the levels and characteristics of chemical substance potential exposure routes, and threat to wildlife and fish population (the endangerment assessment prepared in Task 5a should be used for this). The effect of "no action" should be described in terms of the short term effects, the long term exposure to chemical substances, and resulting public health impacts. Each remedial action recommendation shall be evaluated to determine the level of and reduction our time -10 such autistances. exposure to such substances and the reduction over time. The relative reduction in public health impacts for each alternative will be compared to the no action level. off-site measures the relative reduction in impact will be determined by comparing residual levels of each alternative with existing criteria, standards or guidelines acceptable to TEPA and 158. EPA. For source control measures, or when criteria, standards, or quidelines are not available, the comparison should be made based the relative on effectiveness.

The relative reduction in public health impacts for each alternative will be compared by listing alternatives according to increasing levels of protection. The no action alternative will serve as the baseline for the analyses.

C. Cost Analyses

Evaluate the cost of each feasible remedial action alternative (and for each phase or segment of the alternative). The cost will be presented in the form of present cost and will include the total cost of implementing the alternative and the annual operating and maintenance cost. Both direct costs and associated indirect costs will be included. A distribution of costs over time will be provided.

D. Evaluation and Recommendation of Cost-Effective Alternative

Alternatives shall be evaluated using technical, environmental, and economic criteria. At a minimum, the following areas will be used to evaluate alternatives:

1. Reliability. Alternatives that minimize or eliminate the potential for release of waste constituents into the environment will be considered more reliable than other alternatives. For example, disposal methods that would permanently eliminate the potential for the wastes to be recycled back into the environment would be considered more reliable than some other disposal methods. Institutional concerns such as management requirements also will be considered.

- 2. Implementability. The requirements of implementing the alternatives will be considered, including phasing alternatives into operable units and segmenting alternatives.

 The requirements for permits, zoning restrictions, right-of-ways and public acceptance are also examples of factors to be considered.
- 3. Operation and Maintenance Requirements. Preference will be given to projects with lower operation and maintenance requirements, other factors being equal.
- 4. <u>Environmental Effects</u>. Alternatives posing the least impact (or greatest improvement) on the environment will be favored.
- 5. Safety Requirements. On-site and off-site safety requirements during implementation of the alternatives should be considered. Alternatives with lower safety impact and cost will be favored.

rJd:

6. <u>Cost</u>. The remedial alternative with the lowest total present worth cost will be favored. Total present worth cost includes capital cost of implementing the alternative and cost of operation and maintenance of the proposed alternative.

Recommend the most cost-effective alternative that provides an acceptable level of risk to potential receptors. The recommendation will be justified by stating the relative advantages over other alternatives considered. All alternatives shall be given equal consideration. The lowest cost alternative that is technologically feasible and reliable to and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, or the environment will be considered the best cost-effective alternative.

Include These Junes

E. Preliminary Report

Prepare a preliminary report presenting the results of Tasks 9 through 13 and the recommended remedial alternatives. Submit ten copies of the preliminary report to the FWS.

TASK 14 - FINAL REPORT

Prepare a final report for submission to the FWS. The report shall include the results of Tasks 9 through 14. Submit ten copies to the FWS. The Service will review the final report, discuss alternatives with the contractor, Sangamo-Weston and cooperating agencies and select a remedial alternative.

TASK 15 - CONCEPTUAL DESIGN

Prepare a conceptual design of the remedial alternatives selected by the Service. The conceptual design shall include, but is not limited to, the engineering approach including implementation schedule, special implementation requirements, institutional requirements, phasing and segmentation considerations, preliminary design criteria, preliminary site and facility layouts, budget cost estimate (including operation and maintenance cost), operating and maintenance requirements and duration, and an outline of the safety plan including cost impact on implementation. Any additional information required as the basis for the completion of the final remedial design will also be included. The contractor also may be required to revise portions of the community relations plan to reflect the results of the conceptual design.

TASK 16 - ADDITIONAL REQUIREMENT'S

The pare Reporting requirements are described in Task 8 of the remedial investigation scope of work. will be mit during the feasibility study.

Appendices



APPENDIX I

PRIMARY CONTACTS

PRIMARY CONTACTS

Name and Responsibility	Organization and Address	Phone Number
Dr. James Elder Regional Resource Contaminants Assessment Coordinator	U.S. Fish and Wildlife Service Federal Building, Fort Snelling Twin Cities, MN 55111	612/725-3536
Mr. Wayne Adams Refuge Manager	U.S. Fish and Wildlife Service Crab Orchard National Wildlife Refuge P.O. Box J Carterville, IL 62918	618/997-3344
Dr. Dave Stallings Dr. Jim Petty Quality Control/ Quality Assurance	Columbia National Fisheries Research Laboratory U.S. Fish and Wildlife Service Route 1 Columbía, MO 65201	314/875-5399
Mr. Dick Ruelle Illinois Resource Contaminants Assessment Coordinator	U.S. Fish and Wildlife Service 1830 Second Avenue Rock Island, IL 61201	309/793-5800
Contracting and General Services	U.S. Fish and Wildlife Service Federal Building, Fort Snelling Twin Cities, MN 55111	612/725-3580
Cudwey Gaither Mr. Mike O'Thole On-Scene Coordinator	U.S. Environmental Protection Agency 230 South Dearborn Street $SHE-1$ A Chicago, IL 64604	473 5 312/886 -3008
Mr. Bob Cowles Superfund Coordinator	Illinois Environmental Protection Agency 2200 Churchill Road Springfield, IL 62706	217/782-6760
Mr. Bob Hite On-Site Coordinator	Illinois Environmental Protection Agency 2209 West Main Marion, IL 62959	618/997-4371
TEPA Representative Mr. Joe Stuart On-Site Coordinator	Illinois Environmental Protection Agency 2209 West Main Marion, IL 62959	618/997-4371
Mr. Mike Carter Illinois Dept. of Conservation Contact	Regional Fish & Wildlife Manager Illinois Dept. of Conservation R.R. 4, Box 68 Benton, IL 62812	Office: 618/435-8138 Home: 618/883-5961

Ms. Vanessa Musgrave Community Relations	U.S. Environmental Protection Agency 230 South Dearborn Street Chicago, IL 64604	312/886-6128
Mr. Jim Ross Community Relations	U.S. Fish and Wildlife Service Federal Building, Fort Snelling Twin Cities, MN 55111	612/725-3519
Dr. Robert L. Flentge Illinois Dept. of Public Health Contact	<pre>(Ilinois Dept. of Public Health 525 West Jefferson Springfield, IL 62707</pre>	217/785-2439
Mr. Les Frankland Illinois Dept. of Conservation	Illinois Dept. of Conservation 424 Lincoln Tower Plaza Springfield, IL 62706	217/782-6424
Carol Luly Illinois Dept. of Conservation	Illinois Dept. of Conservation 117 W. Main Street Collinsville, IL 62234	618/345-6220
Allisone Ing office of Solution Depth of Interior Davis Daliaferro	18th and C Theet, N.W. wash, D.C. 20240	202-343-530

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Sangamo Weston
Bevery + Diamond

APPENDIX II

Partial list of published and unpublished data available on Crab Orchard Creek watershed and Crab Orchard Lake.

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Put in a Report

1ABLE]. Partial summery of monitoring data and information available on Crab Orchard Creek Matershed and Crab Orchard Lake. Compiled by R.L. Mite.

TYPE OF INFORMATION ON PUBLICATION SITE	GENERAL AREA	DESCRIPTION OF BATA	DATE(S) OR PERIOD OF RECORD	ATAILABILITY
Water and Land Resources of the Crab Orchard Late Bosin, J. B. Stoll, et al, 1954.	Crab Orchard Lake and Watershed	Historical, sedimentation, sediment- soil characteristics, water supply information,	1954	Published by State Water Survey
Big Muddy River Comprehensive Basin Study, Vols 1-7. Propared by several agencies under the supervision of Big Muddy River Basin Coordinating Committee	Blg Muddy Besin including 1 Crab Orchard Creek Basin	Climatology, materorology, surface water hydrology, ground water availability, flood control & drainage, agriculture and economics.	1960 - 1971	1 lbrory
Water Quality Management Easin Plan for the Big Muddy River Basin, IEPA, 1976,	Big Meddy Basin including Crab Orchard Creek Basin IEFA segment A-OS, OS, OF	General water quality data, water quality violations, point source information (pages 17-57 to 17-76).	1975 Cal year	ICPA
City of Marian Report responding to Pollution Control Board Order (PCB 15-220)	Crab Orchard Lake	Phyloplankton Survey	June 24, 1975 July 8, 1975	ICPA Monitoring Units Marion
Biological investigation of the Crab Orchard Crack Basin, Summer 1975, h.L. Hite and M. King	Crab Orchard Creek and Crab Orchard Lake	Water Quality Data Biological Data on Resin Streams, Sediment Chemistry Bosin Streams & Lakes; Fish Flesh Data Crab Orchard Lake	1973-1976 W.Q. Doto for 1972- 1976	IEPA
Juint Mater Quality Study of Crab Orchard Late and Bathing Beaches. Buitt, J. 1976	Crab Orchard take	Bacteriological Data	1976	IDFM-Marton
Report on Crab Orchard Late. EPA Region V. Herking paper No. 201 Halional Eutrophication Survey	Crab Orchard Lake	Mater Quality Data, point source loadings	1973-1974	Region # [FA or FA
IEPA, Antient Water Quality Data	Station MD-04; Crab Orchard Creek E. of Marion at Route 13	moutine Mater (halviy Pr. smeters, Mutrients, Petals, etc.	1977-1984	SIDUEL, IEPA, 1956 reports, and USGS Water Resource Data Series
ILPA Ambient Mater Quality Bata	Station MD-03; Crab Orchard Creek at 1-57, 1.5 miles SC of Marion	Routine Water Quality Parameters, Hulrients, Helais, etc.	1977-1977	SIORET-IEPA; USGS Water Resource Investigations 79- 25 (1973)

TYPE OF INFORMATION OR PUBLICATION TITLE	GENERAL AREA.	DESCRIPTION OF DATA	DATA(S) OR PERIOD OF RECORD	AVAILABILITY
IEPA Ambient Lake Monitoring Program Data	Marian City Reservair: (Lake Code RN-AOS-L)	Mater Quality Data	1977; 1979;1981- 1983	STORET-IEPA Monitoring Unix-Springfield
ILPA Ambient take Monitoring Program Deta	Devils Kitchen take (Late Code RN-AOS-J)	Water Quality Bata	1977; 1979; 1902-1984	\$108[1-1[P4 Monitoring Unit-Springfield
JFPA <i>Re</i> lient Lak e Honitoring Program Dala	Little Grassy Lake (Lake Code RN-AO6-K)	Nater Quality Bata	1977; 1961	SIORET-IEPA Monitoring Unit-Springfield
	Statewide, Bata on Marion Reservoir, Crab Orchard Lake	includes statistical summery of parameter values	1979-1981	Monitoring Unit Morton or Springfield
Classification/Needs Assessment of Illinois Lake for protection, restoration, and management. IEPA Monitoring Unit Report, B.f. Sefton and J.A. Little	State Lakes; includes Crab Orchard Lake, Harion City Reservair, Devils Kitchen and Little Grassy	Water Quality Ratings, improvement potential ratings, public benefits rating and overall late calssification	Published February 1984	1EFA Monitoring Unit- Springfield
lilinois Water Quality Inventory Report 1982-1983 Yalume 1: IEFA Monitorial Unit Report 305b	Statewide,Crab Orchard	Whole fish data for Crob Orchard	March 3, 1983	\$TORET-IEPA menituring Unit-Springfield
Fish Contaminant Data	.7 samples from RT 145 area; 14 samples from dam area	PCD concentrations in fish filets	Merch 1983	Inoc
Survey for Polychlorinated Biphenyls on Crab Orchard Motional Wildlife Pefuge. USF & W Report, R. Ruelle	Crab Ofchard Refuge and	PCB data in dump soils, lake & tributary sediments, lake fish (whole fish)	June-July 1982	A7L T A - WASIS
Percury Levels in Crab Orchard Laig Largemouth Mass 1902 USF B W Perort, R. Rucile	Crab Orchard Lake	Mercury Concentrations in fish filets	Jame 1982	USF B W - Puelle
Survry for lead on Crob Orchard National Wildlife Refuge, USF & # Report, R. Runlle	Crab Orchard Hational Arfuge And Labo	Lead concentrations in solls, earthworms, manuals, and Crab Orthord whole fish		
University of Mebraska tab results for Dump Solls	Sangame Dump	Tetra and Pentachlorodibenzadinalns	August 26, 1983	USF A w - Avette
lish Contaminant data	Marion City Reservoir	Mercury, PCB's and other organichlorine compound in fish filets	May 7, 1934	1000
lish Contaminant Data	Crab Orchard Labo East of Highway 148 and near Nam	Mercury, PCB's and other organichloring compounds in fish filets	March 16, 1995 4 May 18, 1784	ION:
ILAP Draft Report Polychlorinated Niphenyl Hunituring; Crab Orchard Labo, 1983-1984	13 Crab Orchard Lake Sites; one site in Crab Orchard Creek	Mater chemistry including organics/metals and routine ambient parameters; sediment chemistry		[[P4 Punitoring Unit- Springlicid

Table 1 (Con't)

Trac OF INFORMATION OR PUBLICATION TITLE	GEMERAL AREA	DESCRIPTION OF BATA	DATE(S) OR PERIOD OF RECORD	AYAILABILITY
IEPA Ambient Water Quality Bata	Station ND-02; Crab Orchard Craek downstream from Crab Orchard Lake Dam	Acutine Water Quality Parameters, Hulrients, Metals, etc.	1972-1964	STORET, LEPA 2036 reports, and USES Water Resource Data Series
Biological and Mater Quality Survey of Crab Orchard Creek in the vicinity of Morion, IEPA Ponitoring Unit Report M. Kelly et, al.	Crab Orchard Creek	MacroInvertebrate, Water Quality diel, enygen	1979-1940	IEPA Monitoring Unit Marion
169A Municipal Nestepater Treat- ment facility Data	City of Meries, Cartervillo, Crab Orchord Refuge, Pitts- burg, Marion Federal Peni- tentiary	Effluent Data-facility Information	1972-1984	ILPA Field Operation Section (DWPC) Morta
Limnology of Devils Kitchen Lake IEPA Monitoring Unit Report R.L. Mite et.ai,	Devils Kitchen Lake and Grassy Creek	Nator Quality Data for Davils Kitchen Lake and Grassy Creek Stream Hacro- invertebrates, Lake Sediment Chemistry	1979	IEPA-Monitoring Unit Springfield
Limnology of 63 illinois takes. IEPA Honituring Unit Report, Sefton ec.si.	State Lakes Including data from Crab Orchard Lake	Water Chemistry, phytoplanktum sediment chemistry	1979	IEPA Monitoring Unit Springfield
Chemical Analysis of Surficial Sediments from 63 littnois takes IFPA Honitoring Unit Report, M. Kelly and R.L.Hite	State Lakes, Crab Grchard Lake, Harton City Reservoir, Devils Kitchen	Sediment Chemistry	1979	ItPA Monteoring Unit Springfield
Evaluation of Illinois Stream Sediment Data 1974-1980; IEPA Monitoring Unit Report	illinois Streams including Erab Orchard Ereek and other sites in watershed	Sediment Chemistry Date, Classifi- cation of Stream Sediments	1974-1980	IEPA Monitoring Unit Marton
Assessment and Classification of Hillmois Lakes, Volume 1, IEPA Report, 8, Sefton	State takes Including Crab Orchard Lake	tate Morphometry, physical data, inventory of problems, phytoplanking	1978	[[FA Munitering Unit Springfield
Assessment and Classification of Illinois Lakes, Volume II IFPA Report, D. Sefton	State takes including Creb Orchard Late	Physical Data, Water Quality Data	1977	IEPA Monitoring Unit Springfield
IEPA Ambient take Monitoring Program Monitoring Data	Crab Orchard take four Sites: (Lake Code RM-ADG-A)	Water Quality Data	1977; 1979-1984	STORFT-IEPA Monitoria

APPENDIX III

SITE INVESTIGATION PROGRAMS

CONTENTS

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B. SITE BACKGROUND AND SAMPLING SCHEDULES

- 3. Area 11 South Landfill
- 4. Area 11 North Landfill
- 5. Area 11 Acid Pond
- 7. D Area SE Drainage
- 7A. D Area North Lawn
- 8. D Area Surface Water Drainage
- 9. P Area NW Drainage
- 10. Waterworks North Drainage
- 11. P Area SE Drainage
- 11A. P Area North
- 12. Area 14 Landfill
- 13. Area 14 Change House Site
- 14. Area 14 Solvent Storage
- 15. Area 7 Plating Pond
- 16. Area 7 Industrial Site
- 17. Job Corps Landfill
- 18. Area 13 Loading Platform
- 19. Area 13 Bunker 1-3
- 20. D Area South
- 21. Southeast Corner Field

- 22. Old Refuge Shop
- 24. Pepsi-West
- 25. COC at Marion Landfill
- 26. COC bellow Marion STP
- 27. COC below 157 Dredge Area
- 28. Water Tower Landfill
- 29. Fire Station Landfill
- 30. Munition Control Site
- 31. Refuge Control Site
- 32. Area 9 Landfill
- 33. Area 9 Building Complex
- 34. Crab Orchard Lake

INTRODUCTION

Appendix III present the site background and Phase I sampling schedules for each site at Crab Orchard National Wildlife Refuge included in the RI/FS. The general site investigation rationale is discussed under Task 3 of the Scope of Work.

The site background discussions represent information provided by the Refuge Manager and also include observations developed as a result of site visits conducted during the period of March 26 through 28, 1985.

In general, the enclosed sampling and analysis schedules represent Phase I activities only. Based on the results of these analyses, a Phase II sampling and analysis program will be developed to more fully assess the extent of contamination (lateral and vertical) and the involvement with site receptors (groundwater, soils, surface waters, aqualic limits air, wildlife, etc.).

The proposed sampling locations are illustrated on aerial photo overlays for each of the sites. The date of the aerial photo is indicated on each. Composite samples are illustrated by the dotted lines connecting the compositing locations. The sampling and analysis schedules further define the depth of samples and number of grabs within each composite. Groundwater monitor wells and geophysical survey grid lines are also illustrated, where proposed.

Key

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Sample compositing location:

Groundwater Monitor Well:

Geophysical Survey Grid:

Analysis Sets included on the Sampling and Analysis Schedules are defined as follows:

, p				Ar	nalysis	Set,	
		Parameters	Α	В	С	D	E
THE al	1	 Purgeable Priority Pollutants Method 601-Water; Method 8010-Soil Method 602-Water; Method 8020-Soil 	× ×		- -	·×	-
111	3	Acid Extractable Priority PollutantsMethod 625-Water; Method 8020-Soil	×	-		×	60 0 hu
•		3. Base/Neutral Extractable Priority Pollutants - Method 625-Water; Method 8070-Soil	×	-	_	×	
41111		4. Pesticide/PCB Priority Pollutants - Method 608-Water; Method 8080-Soil - Standard Methods-15th Ed., Method 5	× 09B	×	×	x	∕ x
11	5	 Metals (cAP) - ICP scan-Method 1010-Soil - Priority Pollutant Metals by AA Spec (SW 846 Section) 	×	-	-	x	-
n) iiii	€	5. Cyanide 40 CFR-136-335.2; - Method 9010-Soil Hy Kun Signately	×	-	~	×	-
411	7 bagg (4) ² .	7. Indicators - pH-40 CFR136-150.1; Method 9041-Soil - Specific Conductance-40 CFR-136-	×	×	~	×	-
419		150.1; Method 9050-Soil	×	×	-	×	-
4H B		 Total Organic Carbon-40 CFR-136- 415.1; Method 9060-Soil Total Organic Halogens-40 CFR-136- 	×	×	-	×	-
		410.1; Method 9010-Soil	×	X ,	~	×	-
ar 🗳	8	B. Explosives Residues by HPLC	×	-	~	*	-
	g	O. Nitrogen Series: TNX, NH3, NO3 40 CFR Part 136 TM	×	_	-	×	-
1- 4 01	1	10. PCDD/PCDF-Method 613-Water; USEPA Reg. VII-Soil	-	×	-	×	-
	1	11. Cation Exchange Capacity-Method 9050 or 9081-Soil	-	×		-	-
ing å	1	12. Total Phosphorus	×	-	-	×	-
tied		13. Primary and Secondary Drinking Water Standards	-	-	-	~	×
थम व	T	Standards for to analyses total will be per purpo, 111-4	yorm	ed p	on f	allec	chi nez

RI/FS SAMPLING & ANALYSIS SUMMARY

SIT NO		NO.OF	TER ANAL. TYPE	NO.ŪF	LL ANAL. TYPE	NO.OF	ILS ANAL. TYPE	NO.OF	ANAL.	BI NO.OF SAMPL	
3	AREA 11 SOUTH LANDFILL	Ü		Ú	-	3	Ä	i 1	A D	Û	-
4	AREA 11 NORTH LANDFILL	0	-	Û	-	1	D	1	Å	0	-
5	AREA 11 ACID POND	1	Â	0	-	i	A	i	Ĥ	Ō	-
. 7	D AREA SOUTHEAST DRAINAGE	i	A	0	-	0	-	1	ä	Ü	-
8	D AREA SOUTHWEST DRAINAGE	1	Ĥ	. 0	-	ý	-	i	A	0	-
9	D AREA NORTHWEST DRAINAGE	1	A	0	-	0	-	i	Ĥ	0	-
01	WATERWORKS NORTH DRAINAGE	i	À	Û	-	Ũ	-	i	ŭ	5	-
11	P AREA SOUTHEAST DRAINAGE	1	Ĥ	Ü	-	0	-	1	ň	Ģ.	-
7 A	D AREA NORTH LAWN	Ú	-	0	-	lò	Ä	ŷ	-	Ģ	-
11A	P AREA NORTH	Ü	-	0	-	1	Å	7	Á	(v	-
12	AREA 14 LANDFILL	i	Â	0	-	i	À	i	D	ð	-
13	AREA 14 CHANGE HOUSE SITE	9	-	0	-	6	Ĥ	ŷ	-	Ģ	-
14	AREA 14 SOLVENT STORAGE	2	À	0	-	0	-	2	A	0	~
15	AREA 7 PLATING POND	i	Ĥ	1	Ĥ	0	-	i	À	Q	•
lé	AREA 7 INDUSTRIAL SITE	4	A	0	-	7 2	A D	4	A	0	-
17	JOB CORPS LANDFILL	2	A	4	Ĥ	5 2	A D	0	-	Û	-
18	AREA 13 LOADING PLATFORM	0	-	0	-	4	å	0	-	Û	-
19	AREA 13 BUNKER 1-3	0	-	Û	-	5	A	Ü	-	Ů	-
20	D AREA SOUTH	į	A	0	-	0	-	1	A	0	-
21	SOUTHEAST CORNER FIELD	0	-	0	-	4	A	Û	-	0	~
22	OLD REFUGE SHOP	1	Â	Ó	-	Ō	-	1	Ĥ	ý	-
24	PEPSI-WEST	1	À	0	-	0	-	i	Ä	ů	-

RI/FS SAMPLING & ANALYSIS SUMMARY

SIT		NO.OF	TER ANAL.		ANAL.	NO.OF	ILS ANAL.	NO.OF	MENTS ANAL.	BIC NO.OF	ANAL.
25	C.O.CREEK AT MARION LF	SAMPL 3	TYPE A	SAMPL O	TYPE -	SAMPL O	TYPE -	SAMPL 2 1	TYPE A D	SAMPL 0	TYPE -
26	C.O.CREEK BELOW MARION ST	P 2	A	Û	-	Õ	-	2	Ĥ	. 0	-
27	C.O.CREEK BELOW 157 DREDGE	1	A	0	-	0	-	i	D	ŷ	-
28	WATER TOWER LANDFILL	Q	-	2	Á	1 i 1	A D	Ģ	-	ũ	-
29	FIRE STATION LANDFILL	0	-	4	A	5 2	A D	0	-	Ø	-
30	MUNITIONS CONTROL SITE	0		1	Ĥ	1	Ū	0	-	Û	-
31	REFUSE CONTROL SITE	Û	-	1	Ĥ	1	D	0	-	ý	-
32	AREA 9 LANDFILL	0	•	3	Ĥ	0 6 27 7	A B C D	15 0 0 3	Ĥ - - D	Ŷ	-
33	AREA 9 BUILDING COMPLEX	0	-	0	-	201	₽	0	-	0	-
34	CRAB DRCHARD LAKE	15	Ĥ	0	-	Û	-	5	Ĥ	16	Ĥ
	TOTAL NUMBER OF SAMPLES	40		ia		325		53		15	

Sampling Sum	mau	د_2			
No.	Ĺ		LYSIS	SET	
NO. OF SAMPLES	ħ	B	C	D	Ε
WATER	35	_	-	-	5
WELL	16	-	-	-	-
SOILS	72	207	27	17	-
SEDIMENTS	45	-	-	ã	-
BIOTA	ić	-	-	-	-
IATAT	184	7	27	27	5

SITE 3

AREA 11 SOUTH LANDFILL

Background

Areas 11 and 12 are currently abandoned sites of explosives and nitrogen fertilizer manufacturing as well as munitions loading. The Olin Corporation is reported to have operated a dynamite line there which was later reportedly sold to U.S. Powder. A number of fires and explosions are known to have occurred in these areas. azide in the area is suspected. RDX was also mentioned as being involved at this area. Many of the buildings and grounds have been "torched" to remove residuals of flammable material. Most are covered with a speak along ashestes material. Most of the buildings still have asbestos siding underneath black tar. Also, within Area 11 are storage areas where explosive powders were stored in rubber-lined underground trenches. A burning pad is evident to the south of Area 11 where oil residues, 53-calibre powder magazines and small powder cylinders are noticeable on the surface. These areas are included in This not a part of the scope of this project.

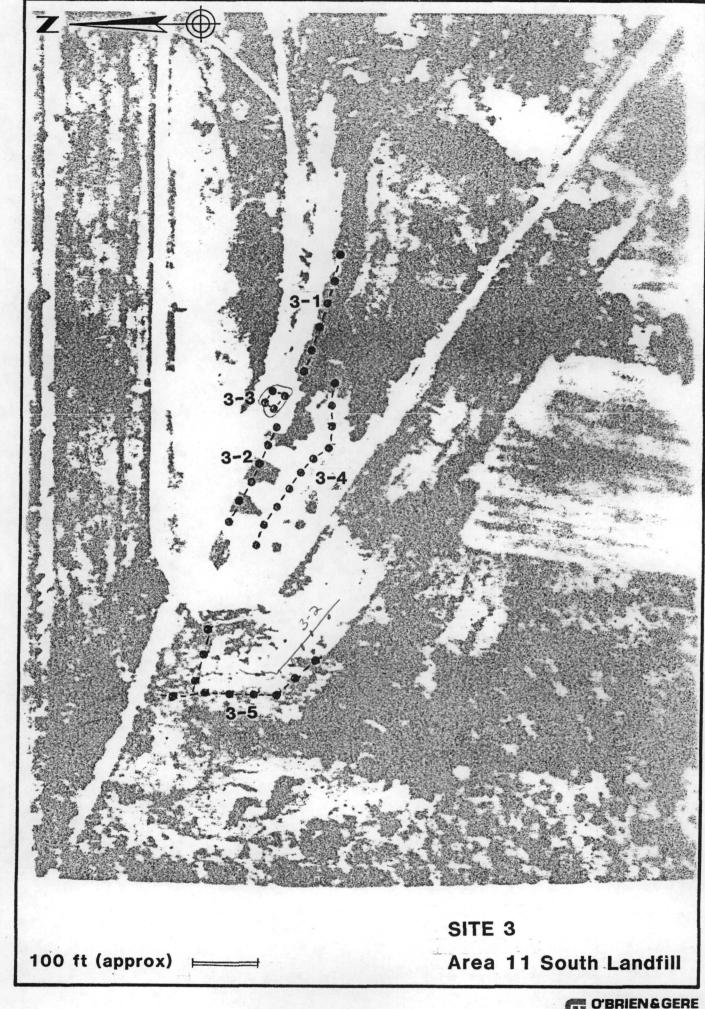
The Area 11 South Landfill is located adjacent to what appears to be an old railroad bed. Much surface and buried litter is evident over an area of perhaps 10 acres. In addition to railroad track, ties and ballast, the following were also observed: cinders and charred wood, powder canisters, piping, metal, mesh, bricks, pumice blocks, 30- and 55-gal drums, reinforcing bars, a laboratory flask and miscellaneous wire and plastic articles. One curious mound toward the east was piled

with a number of powder canisters and had a 4-in stainless steel pipe existing from the bottom. The stream bed west of the road appeared to contain especially heavy concentrations of debris. Black tars and ash were evident in the stream bed.

Sampling and Analysis Schedule

Phase I sampling only will be conducted at this site. Any Phase II sampling and remedial assessments will likely be conducted by the DOD. The following samples are proposed:

I.D.	Matrix	Name	Type	Depth	Analysis Set
		worth			
3-1	Soi1	νο(^{γη} East Bank	Composite of 6 Grabs	0 to 1 ft	Α
3-2	Soil	Go [™] West Bank	Composite of 6 Grabs	0 to 1 ft	Α
3-3	Soil	East Mound	Composite of 4 Grabs	0 to 1 ft	Α
3-4	Sed.	-Swamp-marsh	Composite of 10 Grabs	0 to 1 ft	D
3-5	Sed.	Lower Stream	Composite of 10 Grabs	0 to 1 ft	Α



The information stream bordering with intermittent stream boundaries.

SITE 4

AREA 11 NORTH LANDFILL

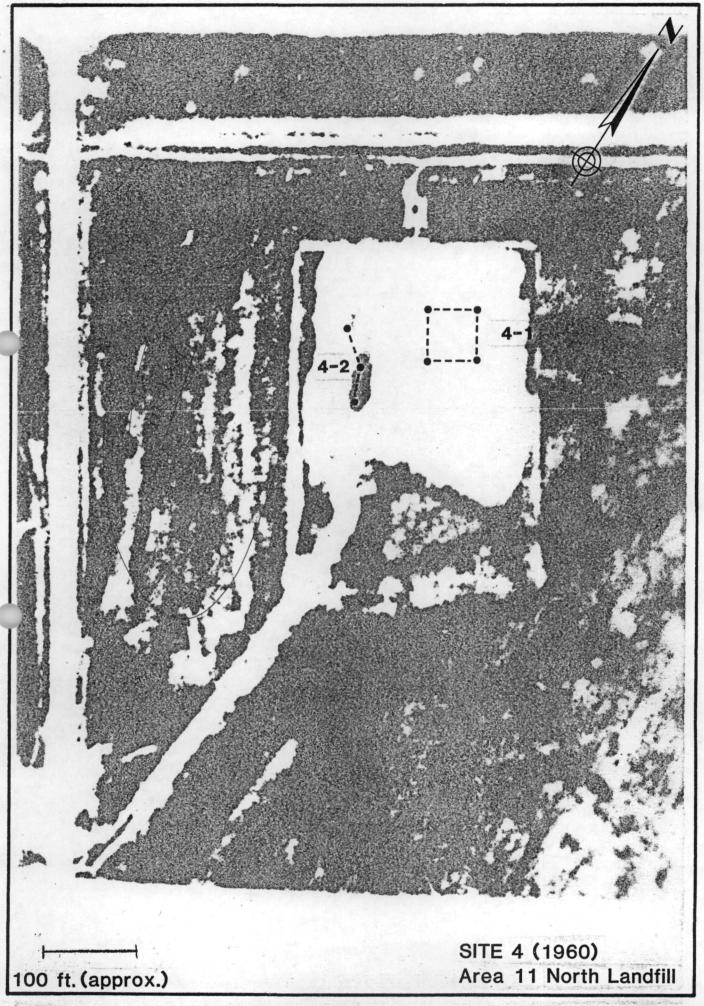
Background

The Area 11 North Landfill appears to have been the site of a filling large (2 to 3 acre) impoundment. The reinforced concrete remains of a purely in the property of the site. A large earth dam can be seen at the northwest end of the site. A large earth bunker (20 to 30 ft high) is located immediately to the west. It may sem musky layon area have been built with earth excavated from the lagoon area and may and may have been built with the protect another throughout to west. have served as protection for the explosives processing areas located further to the west. It was suggested that RDX or magnesium may have been stored underwater here. The level bottom of the impoundment shows a number of bare patches of fine white silt or clay. Other weathered areas showed horizontal layering of white and gray sedidignamete flore A number of fuse wires were noticed here as well as a small powder carrier, 1.5-in dia by 3 in, with the fuse intact. Small lead obelined Surface drainage enters from the south and chunks were also seen. exits north to an adjacent stream bed.

Sampling and Analysis Schedule

Phase I sampling only will be conducted at this site. Any Phase II sampling and remedial assessments will likely be conducted by the DOD. The following samples are proposed:

1.D.	<u>Matrix</u>	Name	Туре	<u>Depth</u>	Analysis Set
4-1	Soil	Bare Patches	Composite of 6 Grabs	0 to 1 ft	D
4-2	Sed.	Swampy Sed.	Composite of 6 Grabs	0 to 1 ft	Α





SITE 5

AREA 11 ACID POND

Background

The Area 11 Acid Pond is a diked impoundment approximately 300 ft x 150 ft which received drainage flowing north from the Area 11 process buildings. The dike extends 5 to 6 ft above the current water the distribution to a facility of the west through a valve box. This drainage then exits through the woods and swampy areas to the north. It is claimed that spillages of (nitric?) acid caused all of the clownstream vertation; downstream vegetation for 1/4 mile to be killed. A large stand of dead along the User, much of the pend.

Sampling and Analysis Schedule

The following Phase I sampling effort is proposed:

<u>I.D.</u>	<u>Matrix</u>	Name	<u>Type</u>	Depth	Analysis Set
5-1	Water	Pond Water	Composite of 4 Grabs	Surface	A
5-2	Sed.	Pond Sed.	Composite of 4 Grabs	0 to 1 ft	A
5-3	Soil	Dead Tree Area	Composite of 4 Grabs	0 to 1 ft	Α

O'BRIEN&GERE ENGINEERS, INC. £- 5

SITES 7, 8, 9, 10 and 11 D AREA SOUTHEAST DRAINAGE D AREA SOUTHWEST DRAINAGE P AREA NORTHWEST DRAINAGE WATERWORKS NORTH DRAINAGE P AREA SOUTHEAST DRAINAGE

Background

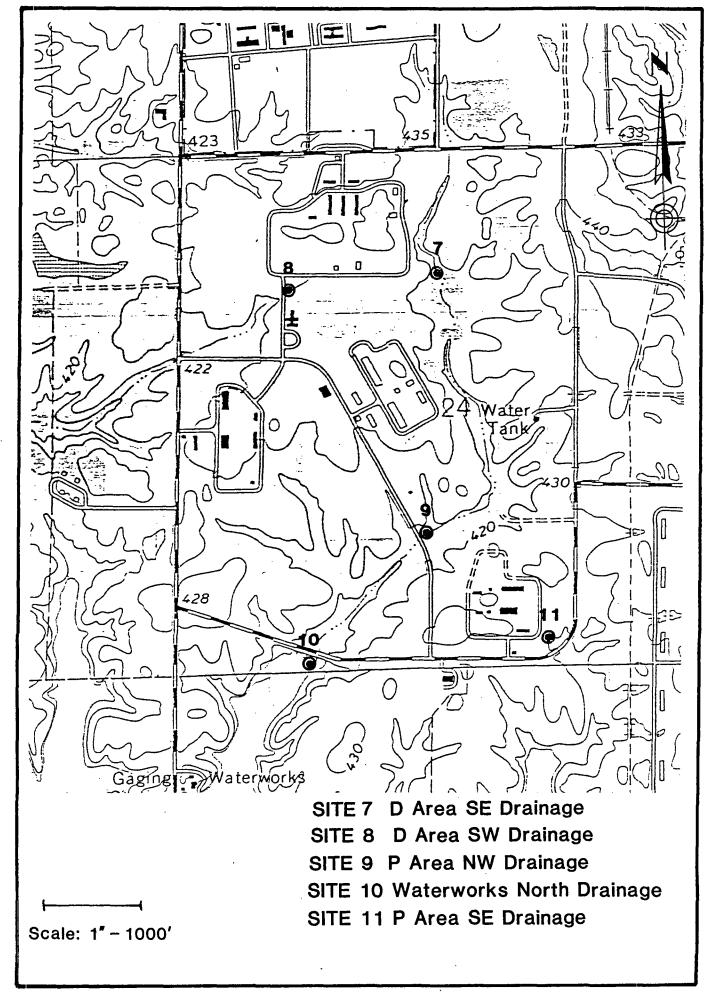
The Olin D and P Areas are active Olin operations north of Crab Orchard Lake. Explosives are currently manufactured in the D Area while research and development is conducted in the P Area. It is likely that chemicals handled in the P Area are non-conventional or "exotic". Universal Match also previously conducted operations here under contract to the DOD. Their operations ceased after a large explosion.

Sites 7, 8, 9, 10 and 11 are locations within various drainage channels leading from the Olin D and P Areas. These discharge to the Lake near the Refuge Waterworks.

Sampling and Analysis Schedule

Samples from each of these sites will consist of a water composite and sediment composite to be taken at each site as follows:

1.D.	Matrix	Name	Туре	<u>Depth</u>	Analysis Set
7-1	Water	D-SE Water	Composite of 4 Grabs	Surf	A
7-2	Sed.	D-SE Sed.	Composite of 4 Grabs	0 to 1 ft	Α
8-1	Water	D-SW Water	Composite of 4 Grabs	Surf	Α
8-2	Sed.	D-SW Sed.	Composite of 4 Grabs	0 to 1 ft	Α
9-1	Water	P-NW Water	Composite of 4 Grabs	Surf	Α
9-2	Sed.	P-NW Sed.	Composite of 4 Grabs	0 to 1 ft	Α
10-1	Water	WW-N Water	Composite of 4 Grabs	Surf	Α
10-2	Sed.	WW-N Sed.	Composite of 4 Grabs	0 to 1 ft	D
11-1	Water	P-SE Water	Composite of 4 Grabs	Surf	Α
11-2	Sed.	P-SE Sed.	Composite of 4 Grabs	0 to 1 ft	A



SITE 7A

D AREA NORTH LAWN

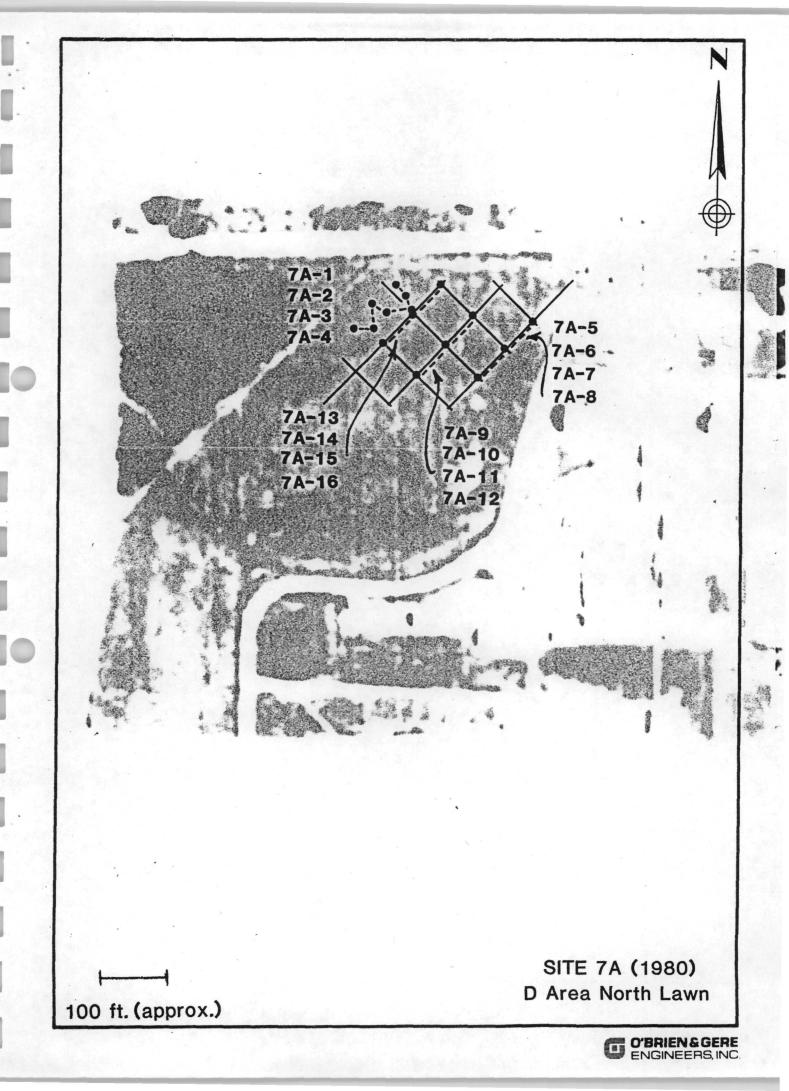
Background

There is a large (about 3 acre) lawn located northwest of the active Olin D Area complex. It is claimed that barrels of chemicals were dumped on a knoll within this lawn. No evidence of a knoll was seen during the site visit, but a number (about 8) of depressed brown patches were evident on the lawn. A visually clean drainage channel is located south of the lawn and exits under the fence to the west. Other stand to the west of the west of the woods from the lawn area.

Sampling and Analysis Schedule

A magnetometer and electromagnetic (EM) survey will be conducted over the 300 ft \times 200 ft lawn area on 20 ft \times 20 ft grid spacings. The purpose of these surveys is to determine if any buried materials are present within the lawn area. Subsequent to the geophysical surveys, soil samples will be obtained in accordance with the following schedule:

1.D.	<u>Matrix</u>	Name	<u>Type</u>	<u>Depth</u>	Analysis Set
7A-1	Soil	Low spots-surf	Composite of 7 Grabs	Surf	A + OVA screen
7A-2	Soil	Low spots-1 ft	Composite of 7 Grabs	1 ft	A + OVA screen
7A-3	Soil	Low spots-2 ft	Composite of 7 Grabs	2 ft	A + OVA screen
7A-4	Soil	Low spots-3 ft	Composite of 7 Grabs	3 ft	A + OVA screen
7A-5	Soil	Transect A-surf	Composite of 3 Grabs	Surf	A + OVA screen
7A-6	Soil	Transect A-1 ft	Composite of 3 Grabs	1 ft	A + OVA screen
7A-7	Soil	Transect A-2 ft	Composite of 3 Grabs	2 ft	A + OVA screen
7A-8	Soil	Transect A-3 ft	Composite of 3 Grabs	3 ft	A + OVA screen
7A-9	Soil	Transect B-surf	Composite of 3 Grabs	Surf	A + OVA screen
7A-10	Soil	Transect B-1 ft	Composite of 3 Grabs	1 ft	A + OVA screen
7A-11	Soil	Transect B-2 Ft	Composite of 3 Grabs	2 ft	A + OVA screen
7A-12	Soil	Transect B-3 ft	Composite of 3 Grabs	3 ft	A + OVA screen
7A-13	Soil	Transect C-surf	Composite of 3 Grabs	Surf	A + OVA screen
7A-14	Soil	Transect C-1 ft	Composite of 3 Grabs	1 ft	A + OVA screen
7A-15	Soil	Transect C-2 ft	Composite of 3 Grabs	2 ft	A + OVA screen
7A-16	Soil	Transect C-3 ft	Composite of 3 Grabs	3 ft	A + OVA screen



SITE 11A

P AREA NORTH

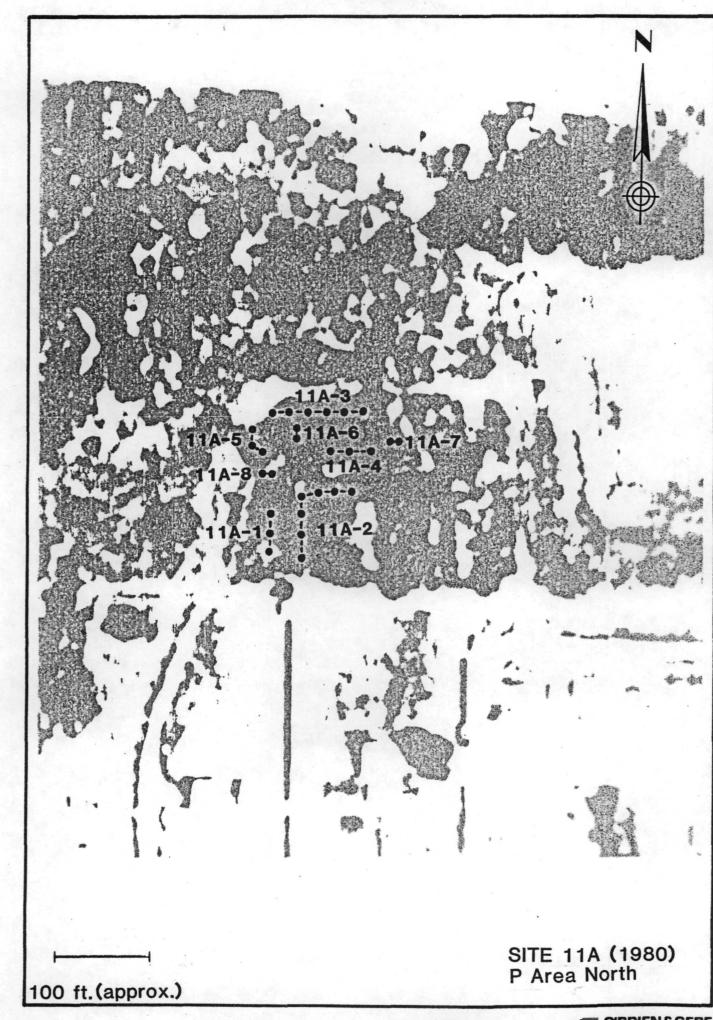
Background

Located outside of the fence north of the Olin P Area is an abandoned L-shaped loading area with connecting covered walkways approximately 100 ft and 85 ft. The central structure contains a loading dock and a steamhouse containing a concrete pit with about 5 ft of clear standing water. An old roadbed runs west and north of the structure and draining swales surround all of the buildings. An abandoned (?) sewer line also runs across the north edge of the site. It has been reported that contaminants were dumped around the buildings.

Sampling and Analysis Schedule

The proposed surface sampling locations focus on low-lying areas with multiple which may have accumulated residues. In addition, four areas adjacent to doorways are proposed for sampling as indicated below.

1.D.	Matrix	Name	Туре	Depth	Analysis Set
11A-1	Sed.	West Swale	Composite of 3 Grabs	0 to 1 ft	Α
11A-2	Sed.	East Swale	Composite of 7 Grabs	0 to 1 ft	Α
11A-3	Sed.	North Swale 1	Composite of 6 Grabs	0 to 1 ft	Α
11A-4	Sed.	North Swale 2	Composite of 3 Grabs	0 to 1 ft	Α
11A-5	Soil	Loading Dock	Composite of 3 Grabs	0 to 1 ft	Α
11A-6	Soil	North Door	Composite of 2 Grabs	0 to 1 ft	Α
11A-7	Soil	East Load Area	Composite of 3 Grabs	0 to 1 ft	Α
11A-8	Soil	Steamhouse Door	Composite of 2 Grabs	0 to 1 ft	Α



AREA 14 LANDFILL

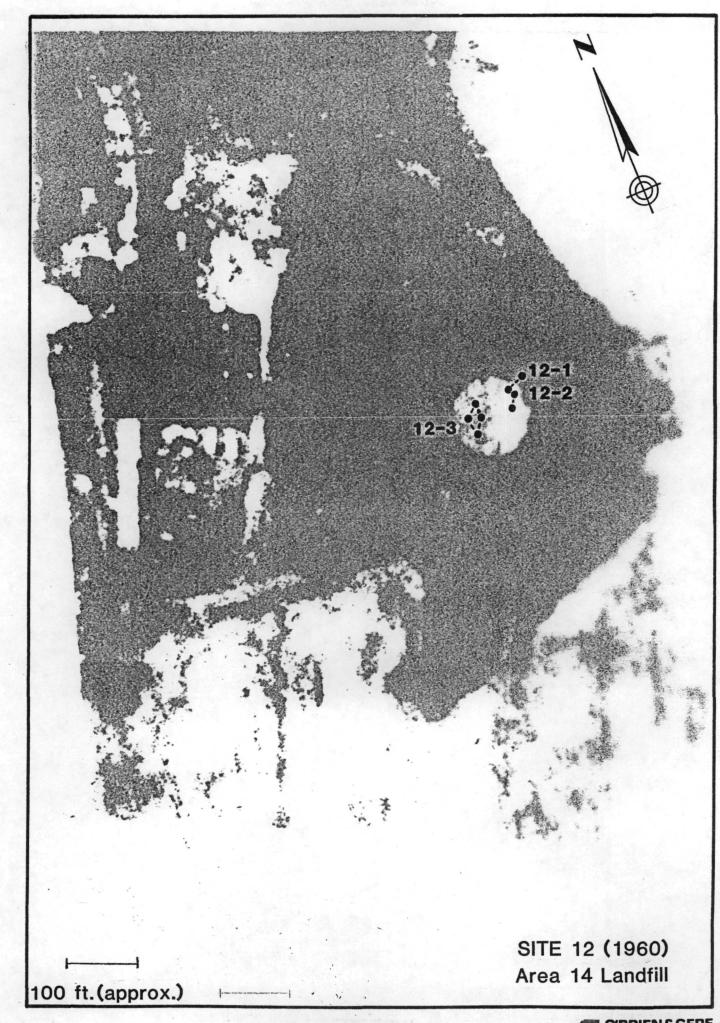
Background

Area 14 was a site of munitions loading activity. Many of the buildings have been abandoned or demolished, but a few industries presently occupy some of the buildings. Historic aerial photos indicated what appeared to be landfill activity in the field east of the present-ly-occupied buildings. During the site visit the remains of a 100-ft dia circular impoundment were found at this site. The interior of the impoundment is presently overgrown with trees with trunk diameters of 8 to 10 in, indicating the date of the impoundment closure at about 1955 to 1965. The impoundment walls are about 6 ft high and the north wall, has been breached to allow drainage to exit. Several black oily pools are evident within and outside the basin. Other bare patches of black sediment and tars are located around the basin floor.

Sampling and Analysis Schedule

The following Phase I samples are proposed:

<u>I.D.</u>	<u>Matrix</u>	<u>Name</u>	Type	Depth	Analysis Set
12-1	Water	Drainage Channel	Composite of 4 Grabs	Surface	Α
12-2	Sed.	Drainage Channel	Composite of 4 Grabs	0 to 1 ft	A
12-3	Soil	Black Residue	Composite of 4 Grabs	0 to 1 ft	D



AREA 14 CHANGE HOUSE SITE

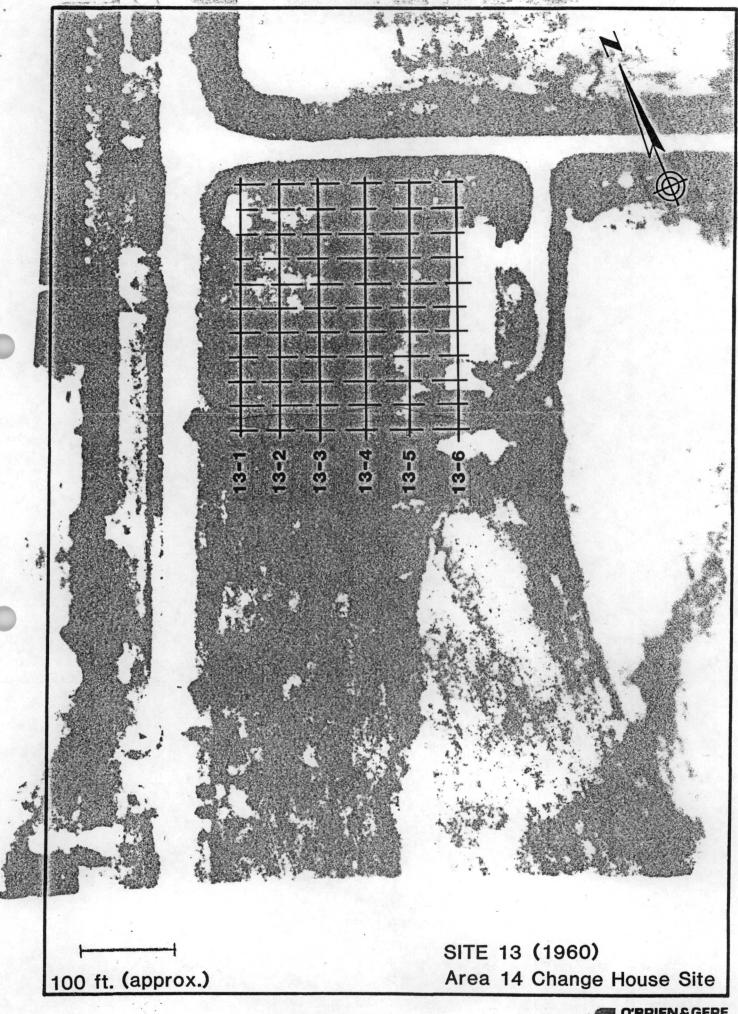
Background

Southeast of the active Diagraph-Bradley buildings on Area 14 was an old building which was recently demolished. Formerly, it was the site of a "Change House" where workers changed their clothing after working in the adjacent bomb-loading buildings. At one time a company named CTI (Chemicals and Technology, Inc.??) manufactured explosives and other chemicals in this building. Other industries may also have been located there. The building was supposedly located on the corner for the roads adjacent to a large mound of dirt. The concrete bad floor for mound. Wind is under this dirt. Air photos show another building further east of the corner; field inspection revealed several 1/2-in iron bars imbedded in concrete pear the corners of this building.

Sampling and Analysis Schedule

A magnetometer and electromagnetic (EM) survey will be conducted $250 \, \mathrm{pt} \, 250 \, \mathrm{pt}$ at this site over a 160-ft x 120-ft area. Grid spacing will be on 10-ft centers. Six north-south transect lines will also be established within this area. Ten grab samples of soils will be obtained along each transect. The following Phase I samples are proposed:

<u>1.D.</u>	<u>Matrix</u>	Name	<u>Туре</u>	Depth	Analysis Set
13-1	Soil	Transect 1	Composite of 10 Grabs	0 to 1 ft	Α
13-2	Soil	Transect 2	Composite of 10 Grabs	0 to 1 ft	Α
13-3	Soil	Transect 3	Composite of 10 Grabs	0 to 1 ft	Α
13-4	Soil	Transect 4	Composite of 10 Grabs	0 to 1 ft	Α
13-5	Soil	Transect 5	Composite of 10 Grabs	0 to 1 ft	Α
13-6	Soil	Transect 6	Composite of 10 Grabs	0 to 1 ft	Α





AREA 14 SOLVENT STORAGE

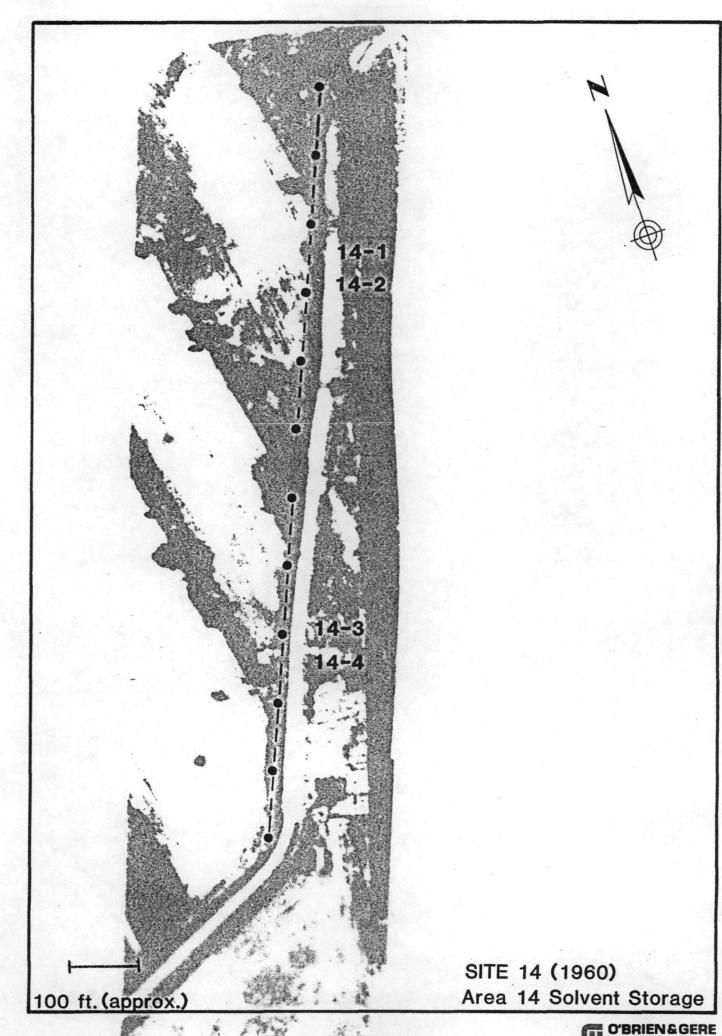
Background

Diagraph-Bradley or Diagraph Marking Systems currently operates within a complex of buildings in Area 14. They produce inks, stencils, stencilboards and marking pens. Linseed oil and various solvents are handled in bulk and in drums here. Some of the bulk solvents noted were: T25 Xylene, T8 Diacetone Alcohol, T9 Diethylene Glycol, and T18 Methyl Cellosolve. Several compressed gas cylinders are also present. At least two drum storage areas containing 50 to 200 drums were also noted. Spill containment facilities are minimal. A drainage ditch runs north along the road behind the west side of the buildings. Process water enters this ditch from a standpipe.

Sampling and Analysis Schedule

Traces of solvent spillage will be evaluated by sampling waters and sediments within the ditch behind the Diagraph-Bradley buildings. The following Phase I samples are proposed:

<u>I.D.</u>	Matrix	Name	Туре	Depth	Analysis Set
14-1	Water	Ditch North	Composite of 6 Grabs	Surface	Α
14-2	Sed.	Ditch North	Composite of 6 Grabs	0 to 1 ft	Α
14-3	Water	Ditch South	Composite of 6 Grabs	Surface	Α
14-4	Sed.	Ditch South	Composite of 6 Grabs	0 to 1 ft	Α



SITES 15 AND 16

AREA 7 PLATING POND

AREA 7 INDUSTRIAL SITE

Background

Area 7 contains a complex of 33 identical buildings which have been used for a variety of industrial purposes during the past 40 years. Each of the six rows of buildings was previously served by a railroad siding.

Within a wooded rise to the south is located a small pond (approximately 50 ft x 30 ft) which is bermed about five ft above the current water level. The current water depth is estimated to be about four ft. It is claimed that this pond was used to receive plating wastewaters from Olin operations which were located in this area at one time. PCBs, lead and other heavy metals may be of concern here.

Many of the buildings in the Area 7 building site are used for dry warehousing purposes. However, two specific locations have been specified for sampling. Buildings 3-4, 3-5, and 4-4 are used by Pennzoil for waste oil recovery and recycling operations for use in mining operations. Black residues are noticeable around some of these buildings. Buildings 5-2 and 5-3 are used by a reclaimer of mining machinery. Black residues are also evident around these buildings. A drainage channel runs from south to north through the center of the site.

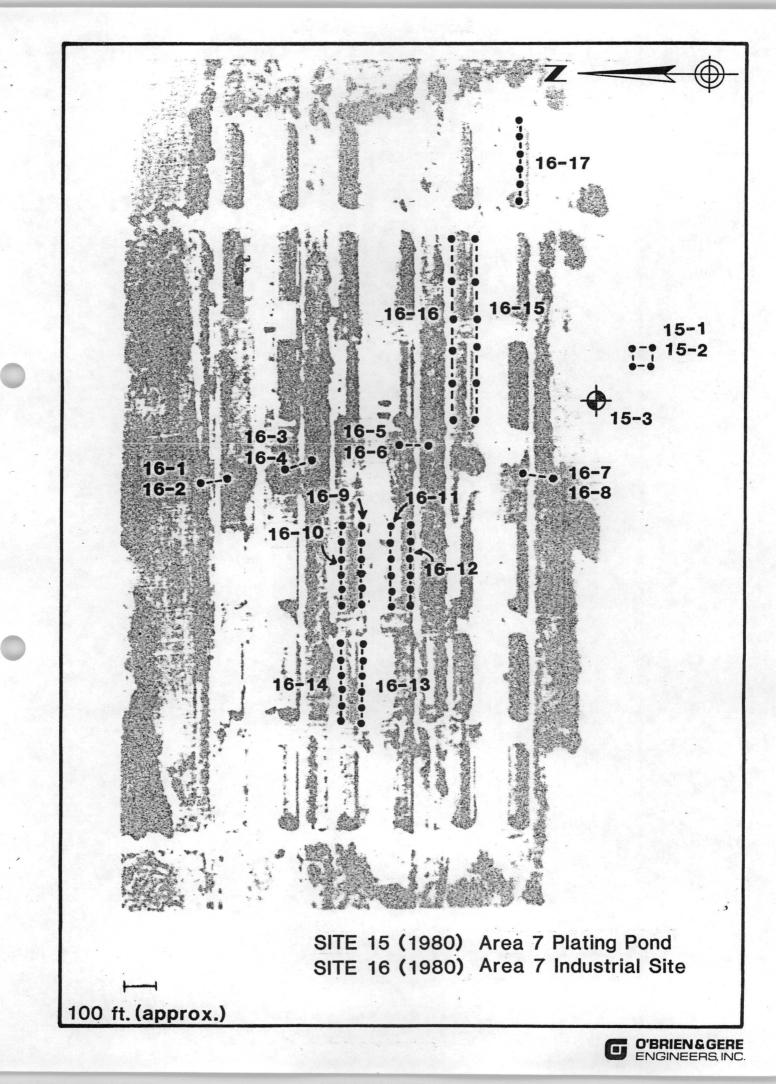
Sampling and Analysis Schedule

Waters and sediments will be sampled within the Area 7 Plating Pond. In addition, a single groundwater monitor well will be installed downgradient of the Plating Pond and sampled for any evidence of groundwater impact.

Composite soil samples will be obtained around several of the building perimeters within Area 7. In addition, waters and sediments will be sampled from the drainage channel which bisects the buildings.

The following Phase I samples are proposed:

1.D.	Matrix	Name	<u>Type</u>	Depth	<u>Analysis Set</u>
15-1	Water	Plating Pond	Composite of 4 Grabs	Surface	Α
15-2	Sed.	Plating Pond	Composite of 4 Grabs	0 to 1 ft	Α
15-3	Water	Monitor Well	Single Sampling	Bailer	Α
16-1	Water	Ditch No. 1	Composite of 2 Grabs	Surface	A
16-2	Sed.	Ditch No. 1	Composite of 2 Grabs	0 to 1 ft	Α
16-3	Water	Ditch No. 2	Composite of 2 Grabs	Surface	Α
16-4	Sed.	Ditch No. 2	Composite of 2 Grabs	0 to 1 ft	Α
16-5	Water	Ditch No. 3	Composite of 2 Grabs	Surface	Α
16-6	Sed.	Ditch No. 3	Composite of 2 Grabs	0 to 1 ft	Α
16-7	Water	Ditch No. 4	Composite of 2 Grabs	Surface	Α
16-8	Sed.	Ditch No. 4	Composite of 2 Grabs	0 to 1 ft	Α
16-9	Soil	Bldg 3-4 Front	Composite of 6 Grabs	0 to 1 ft	D
16-10	Soil	Bldg 3-4 Back	Composite of 6 Grabs	0 to 1 ft	Α
16-11	Soil	Bldg 3-5 Front	Composite of 6 Grabs	0 to 1 ft	Α
16-12	Soil	Bldg 3-5 Back	Composite of 6 Grabs	0 to 1 ft	Α
16-13	Soil	Bldg 4-4 Front	Composite of 6 Grabs	0 to 1 ft	Α
16-14	Soil	Bldg 4-4 Back	Composite of 6 Grabs	0 to 1 ft	Α
16-15	Soil	Bldg 5-2&3 Front	Composite of 6 Grabs	0 to 1 ft	D
16-16	Soi1	Bldg 5-2&3 Back	Composite of 6 Grabs	0 to 1 ft	Α
16-17	Soil	Bldg 6-1 Control	Composite of 6 Grabs	0 to 1 ft	Α



JOB CORPS LANDFILL

Background

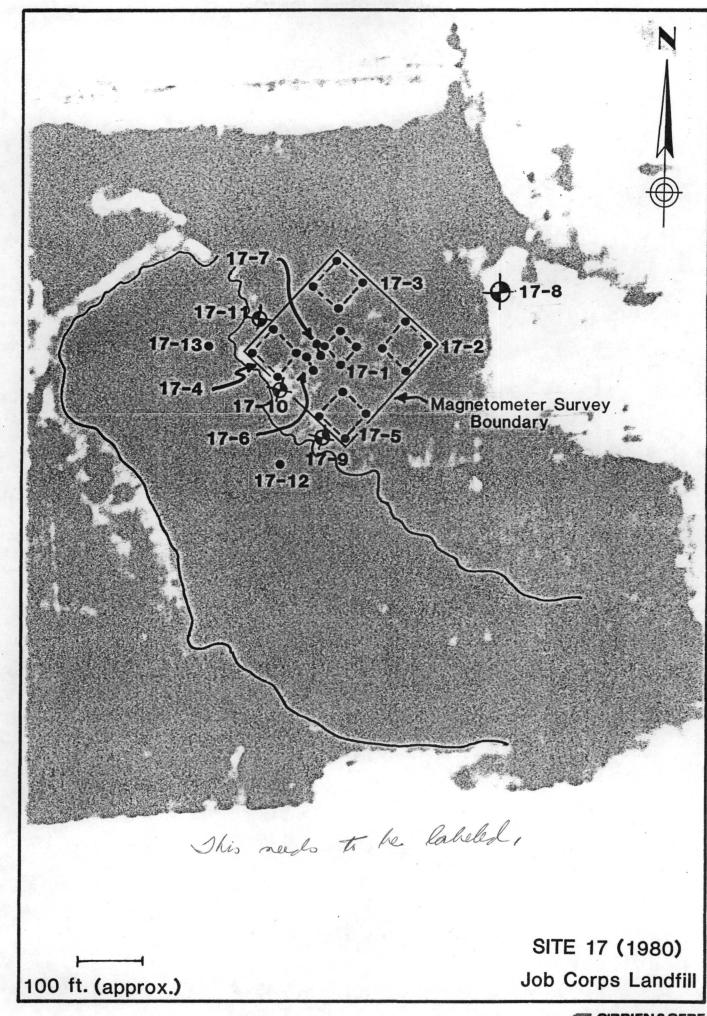
Northeast of the Refuge Waterworks is a small (approximately 10 acre) pond created by Job Corps workers in the mid-1980's. Attention has recently been brought to this pond because as many as a dozen or more geese carcasses have been found floating on the water or littering the shores. Some of these carcasses have been relatively fresh while others were in various state of decay. The Fish and Wildlife Service has completed a number of analyses of these carcasses and has ruled out a variety of potential chemical causes. A definite conclusion has not yet been reached.

The "Job Corps" landfill was discovered while investigating the geese kills. It is located within a wooded area to the north of the pond and covers an area of perhaps an acre of more. It appears to be mainly surface litter dumped in spots and perhaps spread around, although deeper spots cannot be ruled out. Many of the surface articles appear to be connected with food preparation, e.g. instutional-size food cans, and a variety of bottles. The bottle styles and labels suggest a date of the mid-1950's, which was consistent with a 1956 Illinois automobile license plate also found. Many of the debris piles are overgrown by thick brush. Two bare patches (less than 6-ft diameter each) were located among the debris. Mica flakes and small electrical contacts were found in one of these. It is claimed that small electrical capacitors were also found here, but none were noted during this site visit. Probing with a trowel revealed no further debris beneath the top inch. orie

Sampling and Analysis Schedule

A magnetometer and electromagnetic (EM) survey will be conducted over a 200 ft x 200 ft area on 10 ft x 10 ft grid spacings. Soil samples will be composited within five 50-ft sided square grids within the land-fill area. In addition, soil samples will be obtained from each of the two bare patches. Depth of soil samples is planned to 1 ft, but contingent upon the results of the geophysical surveys. Four shallow wells will be placed (3 downgradient and 1 upgradient) and sampled. Two surface waters from the pond will also be analyzed. The following Phase I samples are proposed:

1.D.	Matrix	Name	<u>Type</u>	Depth	<u>Analysis Set</u>
17-1	Soil	Soil Grid 1	Composite of 5 Grabs	0 to 1 ft	Α
17-2	Soil	Soil Grid 2	Composite of 5 Grabs	0 to 1 ft	Α
17-3	Soil	Soil Grid 3	Composite of 5 Grabs	0 to 1 ft	D
17-4	Soil	Soil Grid 4	Composite of 5 Grabs	0 to 1 ft	Α
17 - 5	Soil	Soil Grid 5	Composite of 5 Grabs	0 to 1 ft	Α
17-6	Soil	Bare Patch 1	Composite of 2 Grabs	0 to 1 ft	D
17-7	Soil	Bare Patch 2	Composite of 2 Grabs	Surface	Α
17-8	Water	Well 17-1	Single Sampling	Bailer	Α
17-9	Water	Well 17-2	Single Sampling	Bailer	Α
17-10	Water	Well 17-3	Single Sampling	Bailer	Α
17-11	Water	Well 17-4	Single Sampling	Bailer	Α
17-12	Water	Pond No. 1	Single Sampling	Surface	Α
17-13	Water	Pond No. 2	Single Sampling	Surface	Α
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O'BRIEN & GERE ENGINEERS, INC.

AREA 13 LOADING PLATFORM

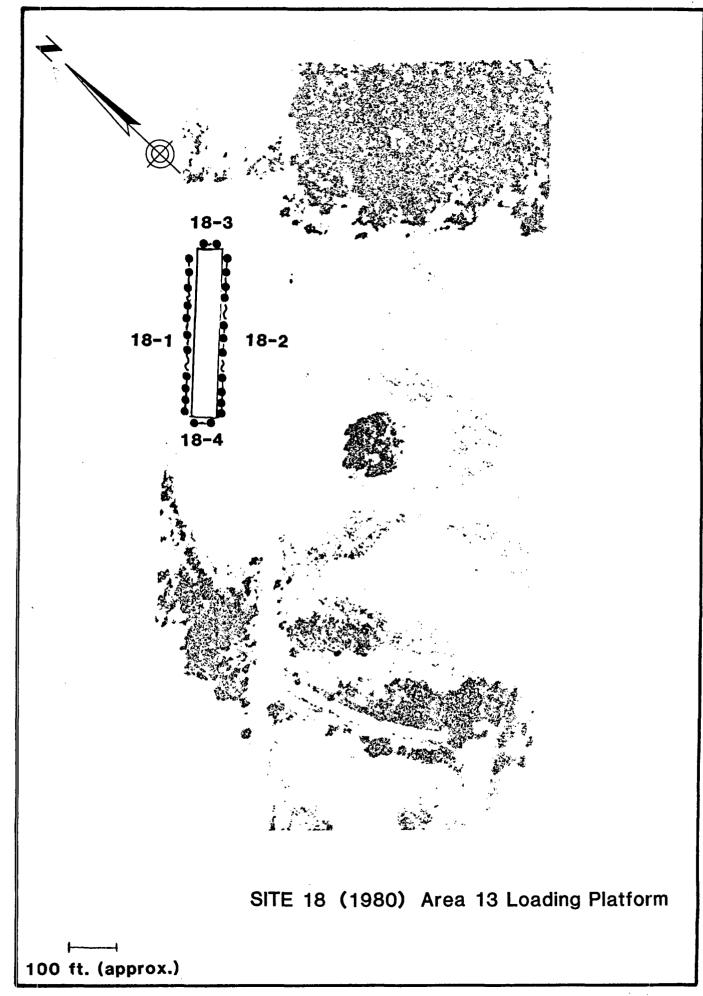
Background

On the northwest end of the Area 13 munitions storage bunkers is a concrete loading platform adjacent to the railroad bed entrance. It is munition light reported that chemicals were dumped off the platform. The site in-278 soft high Concrete spection indicated that the loading dock is about 235 ft long by 10 ft about wide. The posts are spaced 19 ft apart. The northwest side contains (probably from vide vailous led) with a small number of runs waters stone bedding with a number of wet spots. No unusual vegetation changes were detected. The only unusual item was a pile of dirt and stone rubble off the west end of the dock with a rusted drum shell nearby.

Sampling and Analysis Schedule

Samples of soil will be obtained from each edge of the loading dock according to the following schedule:

1.D.	<u>Matrix</u>	Name	<u>Type</u>	Depth	Analysis Set
18-1	Soi1	Loading Dock N	Composite of 20 Grabs	0 to 1 ft	Α
18-2	Soi1	Loading Dock S	Composite of 20 Grabs	0 to 1 ft	Α
18-3	Soil	Loading Dock E	Composite of 2 Grabs	0 to 1 ft	Α
18-4	Soil	Loading Dock W	Composite of 2 Grabs	0 to 1 ft	Α



AREA 13 BUNKER 1-3

Background

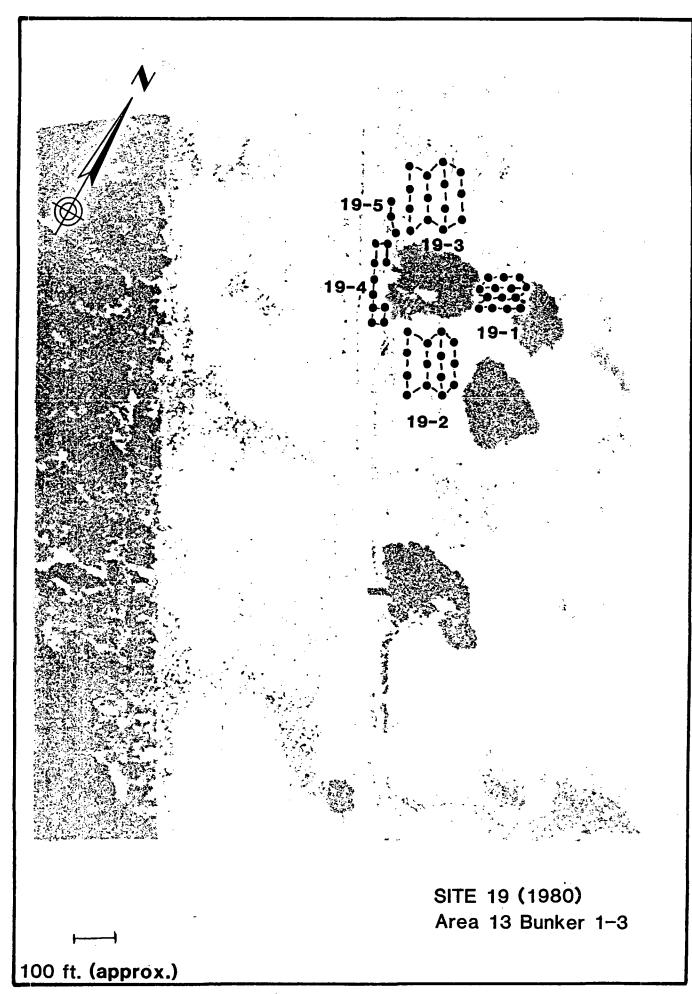
Area 13 contains approximately 85 bunkers which were originally built for storage of 500-lb bombs. Most of them still contain explosives, leased mainly to Olin and U.S. Powder. Corn fields are cultivated between the bunkers. Formerly, they were fruit orchards.

It has been reported that chemicals were poured out near Bunker 1-3, probably in the field next to it. A site inspection did not reveal any significant signs of impact. Evidence of fill activity (scattered red bricks) is widespread. An L-shaped area of brown vegetation difference was noted to the southwest side of the bunker.

Sampling and Analysis Schedule

Soil samples will be composited within three 50-ft sided square grids adjacent to Bunker 1-3. In addition, ten soil samples will be composited from the front side of the bunker and a composite will be obtained from the brown patch to the northwest. The following Phase I samples are proposed:

<u>1.D.</u>	<u>Matrix</u>	Name	Туре	<u>Depth</u>	Analysis Set
19-1	Soil	Soil Grid NE	Composite of 14 Grabs	0 to 1 ft	Α
19-2	Soi 1	Soil Grid SE	Composite of 14 Grabs	0 to 1 ft	Α
19-3	Soil	Soil Grid NW	Composite of 14 Grabs	0 to 1 ft	Α
19-4	Soil	Soil Grid Front	Composite of 10 Grabs	0 to 1 ft	Α
19-5	Soil	Br. Patch Transct	Composite of 3 Grabs	0 to 1 ft	Α



D AREA SOUTH

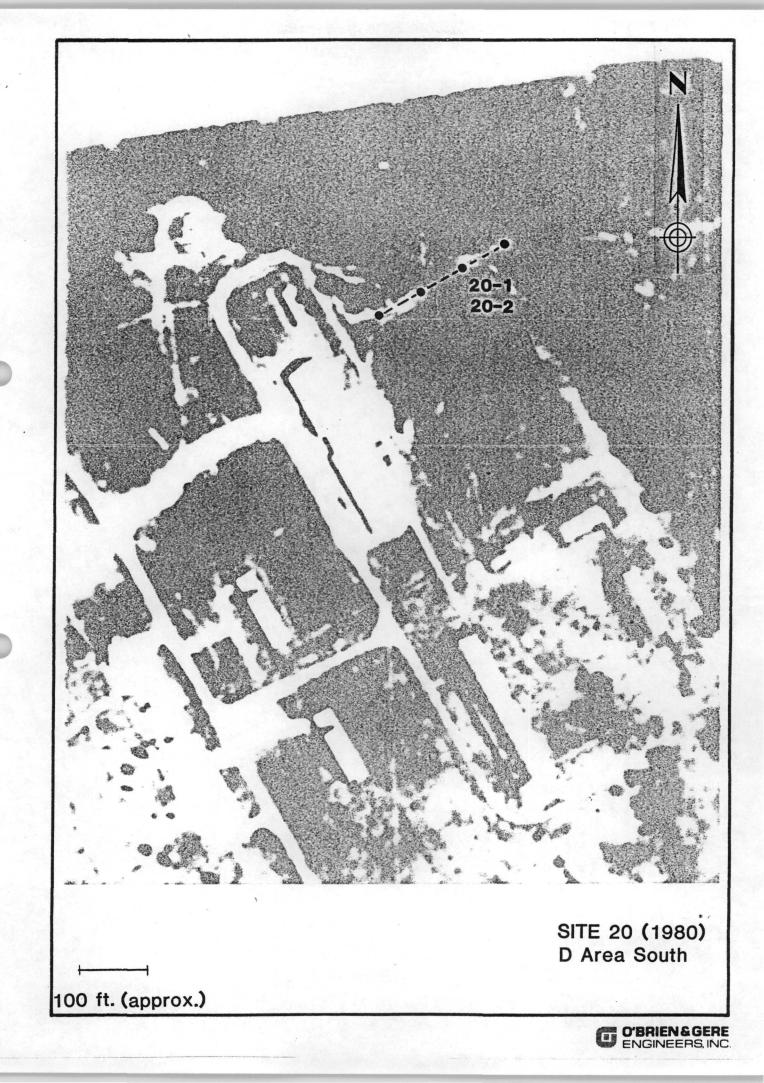
Background

An abandoned building is located within the fenced southeastern end of the Olin D Complex. It was reported that chemicals were dumped here. A drainage swale originating at the building runs east outside of the fence. A four-in pipe (dripping) also discharges to this ditch, possibly from the active Olin area. A slight sheen was noticeable in pooled areas of the ditch.

Sampling and Analysis Schedule

Waters and sediments will be composited from the ditch in accordance with the following Phase I schedule:

<u>1.D.</u>	Matrix	<u>Name</u>	Туре	Depth	Analysis Set
20-1	Water	D South	Composite of 4 Grabs	Surface	Α
20-2	Sed.	D South	Composite of 4 Grabs	0 to 1 ft	Α



SOUTHEAST CORNER FIELD

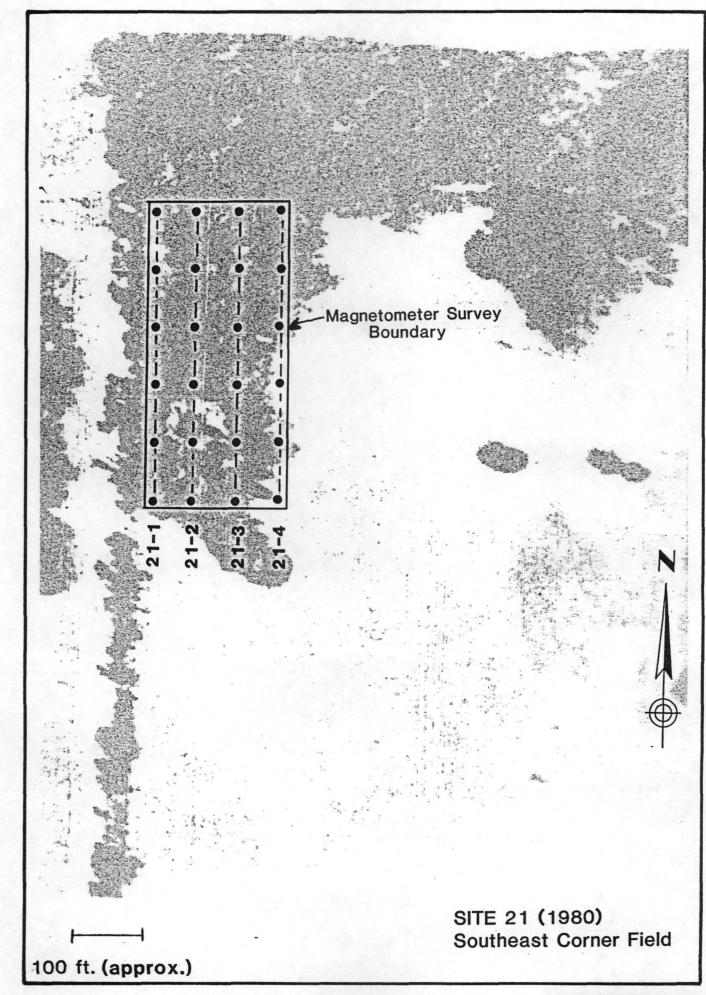
Background

At the southeast corner of the refuge is a field which is thought to be the site of a very old landfill. A pile of concrete pieces is located immediately inside the fence. The topography drops off to the south and east with a swampy drainage ditch at the bottom of the slope. No other evidence of debris could be found. Trees as large as 24-in diameter suggest that the area has not seen any major activity within the past 60 to 70 years.

Sampling and Analysis Schedule

A magnetometer and electromagnetic (EM) survey will be conducted within the 200-ft \times 125-ft area along four north-south transects. Soil composites will also be taken along these same transects as follows:

I.D.	<u>Matrix</u>	Name	Туре	Depth	Analysis Set
21-1	Soil	Transect 1	Composite of 6 Grabs	0 to 1 ft	A
21-2	Soil	Transect 2	Composite of 6 Grabs	0 to 1 ft	Α
21-3	Soil	Transect 3	Composite of 6 Grabs	0 to 1 ft	Α
21-4	Soil	Transect 4	Composite of 6 Grabs	0 to 1 ft	Α



OLD REFUGE SHOP

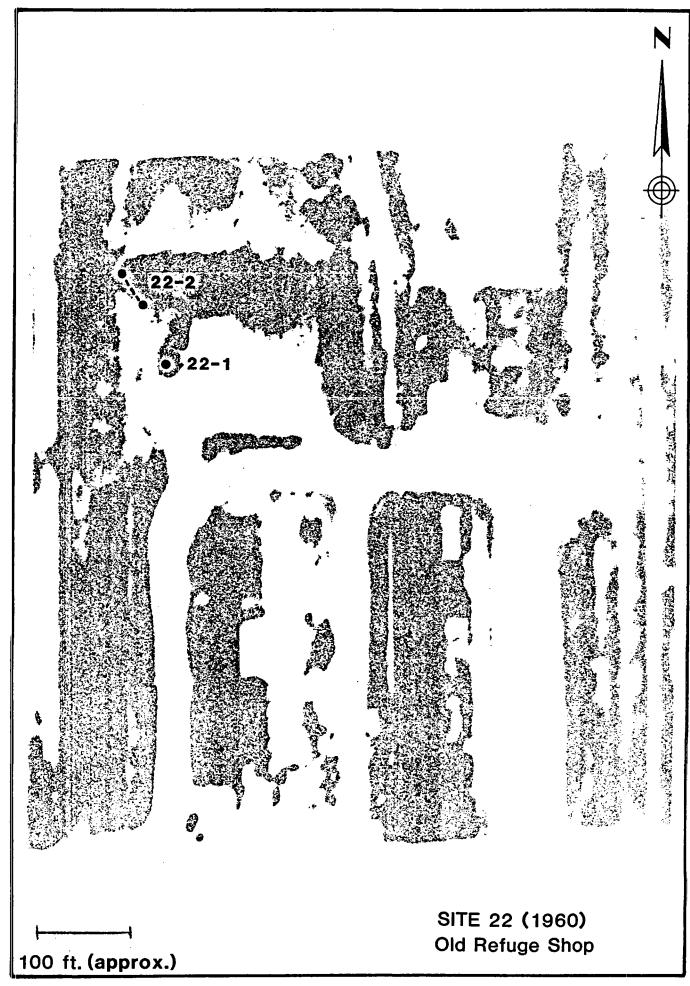
Background

North of the refuge along Wolf Creek Road is the old refuge headquarters, now leased by Diagraph Bradley. Behind this building is located the old shop area of the refuge. Pine poles were treated here with pentachlorphenol and shipped to various spots around the country. Outside the fence to the north is a small pool which receives drainage from the old shop area. The pool contains a green-yellow scum and drains through the woods to the northwest.

Sampling and Analysis Schedule

The following samples will be obtained as part of Phase I:

1.D.	<u>Matrix</u>	Name	<u>Type</u>	<u>Depth</u>	Analysis Set
22-1	Water	Pool Water	Single Grab	Surface	Α
22-2	Sed.	Stream Sed.	Composite of 2 Grabs	0 to 1 ft	Α



PEPSI-WEST

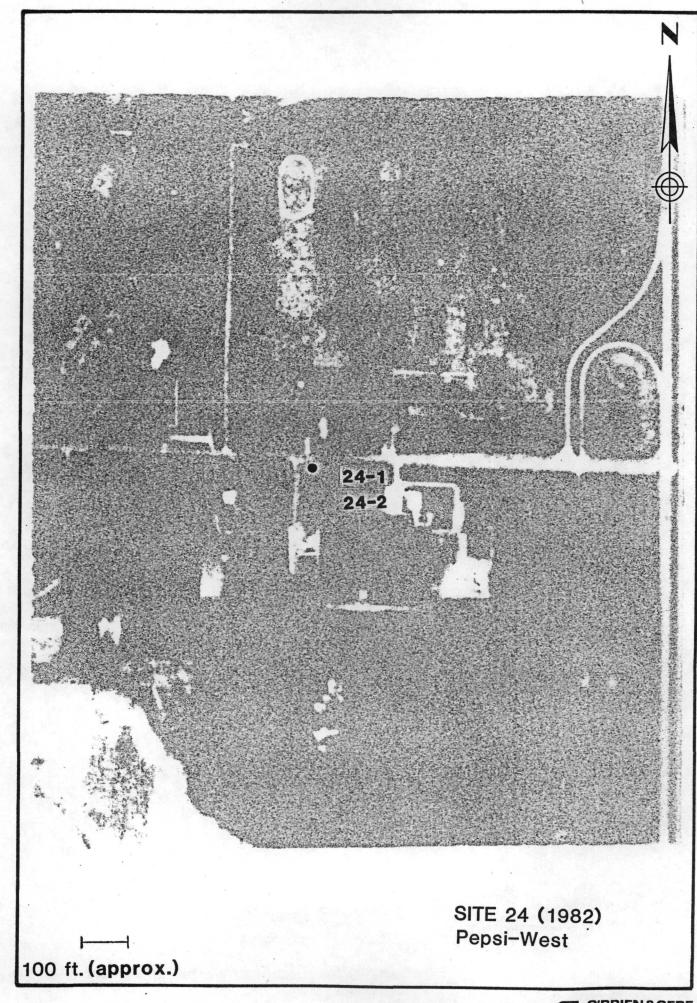
Background

The Pepsi Cola Bottling Company in Marion could potentially discharge to Crab Orchard Creek. It is not known whether the City or State monitor environmental activities here. A site inspection indicated that it was unlikely that discharges issued directly south to the Creek, since the entire south end of the property rises 4 to 8 ft in elevation above the parking lot. Drainage ditches, however, were located to the north adjacent to the street. These probably receive surface runoff only.

Sampling and Analysis Schedule

A single grab sample will be obtained from the north ditch during Phase I.

<u>1.D.</u>	Matrix	Name	<u>Type</u>	Depth	<u>Analysis Set</u>
24-1	Water	Pepsi-West	Single Grab	Surface	Α
24-1	Sed.	Pepsi-West	Single Grab	0 to 1 ft	Α



CRAB ORCHARD CREEK AT MARION LANDFILL

Background

The old Marion landfill is off Old Creal Springs Road and directly abuts Crab Orchard Creek. It has apparently been inactive for a number of years. A visible face of trash can be seen by travelling upstream several hundred yards from the road. Near to this is a small pond (approximately 3/4 acre).

Sampling and Analysis Schedule

The following samples are proposed for Phase I:

1.D.	Matrix	Name	Туре	Depth	Analysis Set
25-1	Water	COC Downstream	Composite of 3 Grabs	Surface	Α
25-2	Sed.	COC Downstream	Composite of 3 Grabs	0 to 1 ft	D
25-3	Water	COC Upstream	Composite of 3 Grabs	Surface	Α
25-4	Sed.	COC Upstream	Composite of 3 Grabs	0 to 1 ft	Α
25-5	Water	LF Pond	Composite of 3 Grabs	Surface	Α
25-6	Sed.	LF Pond	Composite of 3 Grabs	0 to 1 ft	Α

SITES 26 AND 27

CRAB ORCHARD CREEK BELOW MARION STP CRAB ORCHARD CREEK BELOW 157 DREDGE AREA

Background

The Marion sewage treatment plant discharges to Crab Orchard Creek somewhere upstream of Court Street. A number of samples downstream from the Marion STP are scheduled to assess the quality of various stretches of Crab Orchard Creek.

Sampling and Analysis Schedule

The following samples are schedule for Phase I:

1.D.	Matrix	Name	Туре	Depth	Analysis Set
26-1	Water	COC at Court St.	Composite of 3 Grabs	Surface	Α
26-2	Sed.	COC at Court St.	Composite of 3 Grabs	0 to 1 ft	Α
26-3	Water	COC at S. Carbon	Composite of 3 Grabs	Surface	Α
26-4	Sed.	COC at S. Carbon	Composite of 3 Grabs	0 to 1 ft	Α
27-1	Water	COC at Chammness	Composite of 3 Grabs	Surface	Α
27-2	Sed.	COC at Chammness	Composite of 3 Grabs	0 to 1 ft	D

WATER TOWER LANDFILL

Background

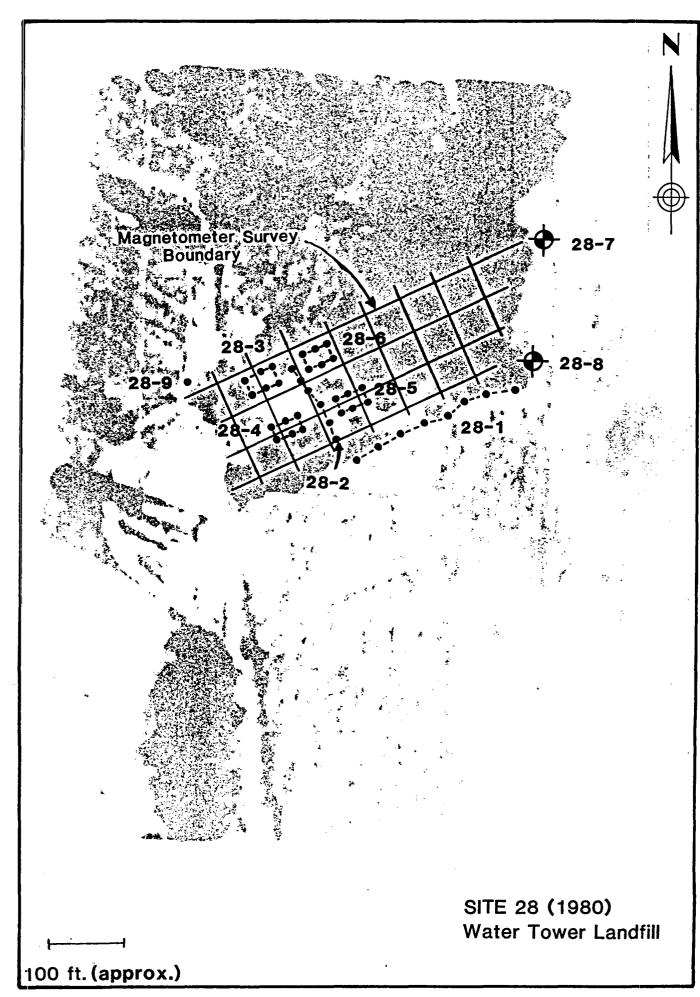
Aerial photos indicate landfilling activities adjacent to the water tower near Areas 7 and 14. These activities are not visually apparent today. The sloping face northeast of the water tower is heavily overgrown with briars and rutted with several major gullies. Only a small amount of refuse is evident on this slope. A previous soil sample taken in this area showed 800 ppm lead concentration. More activity is evident in the woods at the bottom of the slope. A number of rusted drums, metal parts and tar residues can be found here. Standing water in the main drainage gully shows a slight sheen on the surface. Several small mounds are within the woods and a larger mound is located at the top of the hill.

Sampling and Analysis Schedule

Magnetometer and electromagnetic (EM) transect lines will be established along and transverse to the slope to detect locations of subsurface debris. Soil samples will be obtained from the main gully and main transverse gully in addition to four rectangular sampling grids. Six additional grab samples will be obtained at the discretion of the field geologist. Two shallow groundwater monitor wells will be installed at the foot of the hill. The following Phase I sampling program is schedule:

G O'BRIEN&GERE

1.D.	<u>Matrix</u>	Name	<u>Type</u>	Depth	Analysis Set
28-1	Soil	Main Gully	Composite of 8 Grabs	0 to 1 ft	D
28-2	Soil	Trans. Gully	Composite of 6 Grabs	0 to 1 ft	Α
28-3	Soi1	Soil Grid 1	Composite of 6 Grabs	0 to 1 ft	Α
28-4	Soil	Soil Grid 2	Composite of 6 Grabs	0 to 1 ft	Α
28-5	Soil	Soil Grid 3	Composite of 6 Grabs	0 to 1 ft	Α
28-6	Soi1	Soil Grid 4	Composite of 6 Grabs	0 to 1 ft	Α
28-7	Water	Well 28-1	Single Grab	Bailer	. А
28-8	Water	Well 28-2	Single Grab	Bailer	Α
28-9	Soil	Xtra 1	Grab	0 to 1 ft	Α
28-10	Soi1	Xtra 2	Grab	0 to 1 ft	Α
28-11	Soi1	Xtra 3	Grab	0 to 1 ft	Α
28-12	Soi1	Xtra 4	Grab	0 to 1 ft	Α
28-13	Soi1	Xtra 5	Grab	0 to 1 ft	Α
28-14	Soil	Xtra 6	Grab	0 to 1 ft	Α



FIRE STATION LANDFILL

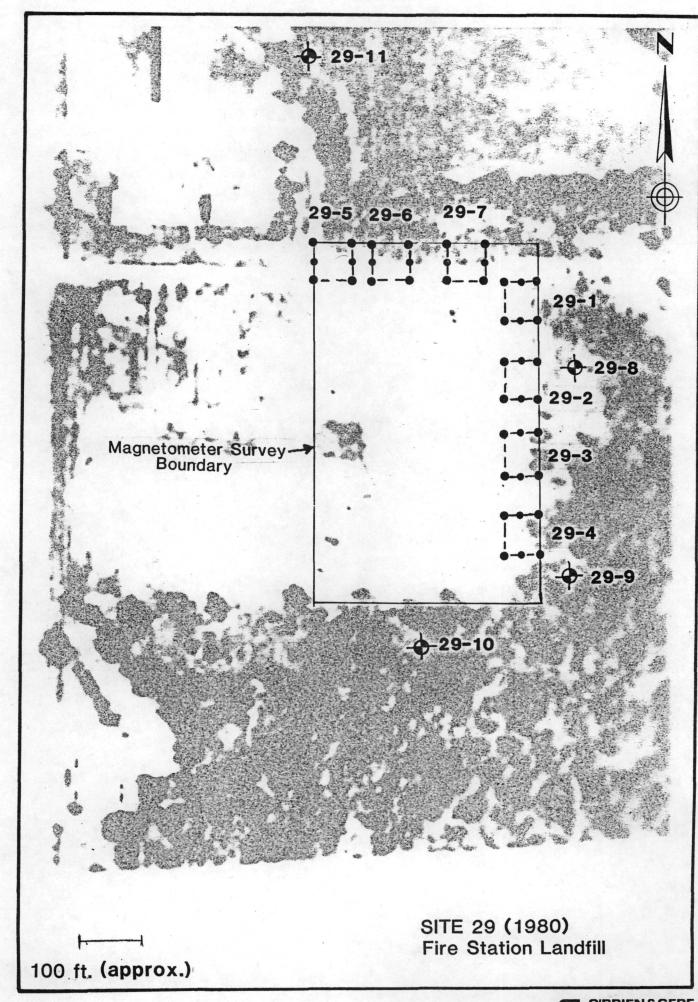
Background

Located southwest of the refuge fire station is a large field which was used for storage of mining machinery until several years ago. The northern and western edges of this field show evidence of a large dump site. Debris is evident on the face which drops 4-5 ft. to a swampy area to the west. Previous sampling near an evergreen tree on the north side showed lead concentrations of 553 ppm. A slight sheen is noted in spots within the swamp. Most of the debris consists of concrete, metal, wire and other machinery-related items. It was reported that Olin dumped heavily here and there once was a very hot fire. Ignitable magnesium is suspected to be in the fill. An empty 30-gal drum labelled "Magnesium Powder" was found along the south portion of the eastern face.

Sampling and Analysis Schedule

A magnetometer and electromagnetic (EM) survey will be conducted over the 350-ft × 300-ft eastern end of the field on grid spacings of 20 ft. Four rectangular soil compositing grids will be established along the eastern face and three similar grids will be established on the northern face. In addition, four groundwater monitor wells will be located (three downgradient and one upgradient). Sampling for Phase I will be as follows:

1.D.	Matrix	<u>Namė</u>	Туре	Depth	<u>Analysis Set</u>
29-1	Soil	E. Face 1	Composite of 12 Grabs	0 and 1 ft	A
29-2	Soil	E. Face 2	Composite of 12 Grabs	0 and 1 ft	Α
29-3	Soil	E. Face 3	Composite of 12 Grabs	0 and 1 ft	۵
29-4	Soil	E. Face 4	Composite of 12 Grabs	0 and 1 ft	Α
29-5	Soil	N. Face 1	Composite of 12 Grabs	0 and 1 ft	A
29-6	Soi1	N. Face 2	Composite of 12 Grabs	0 and 1 ft	D
29-7	Soil	N. Face 3	Composite of 12 Grabs	0 and 1 ft	· А
29-8	Water	Well 29-1	Single Grab	Bailer	Α
29-9	Water	Well 29-2	Single Grab	Bailer	Α
29-10	Water	Well 29-3	Single Grab	Bailer	Α
29-11	Water	Well 29-4	Single Grab	Bailer	Α

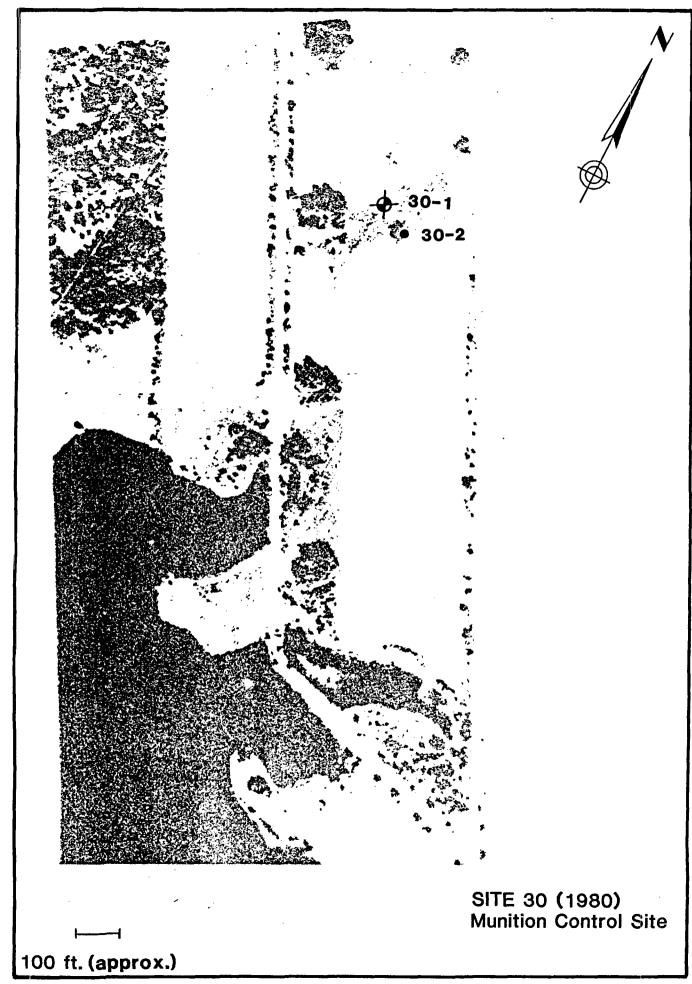


MUNITION CONTROL SITE

A munition control site will be established on an area where the operations involved only ammunitions manufacture.

Sampling and Analysis Scheduled

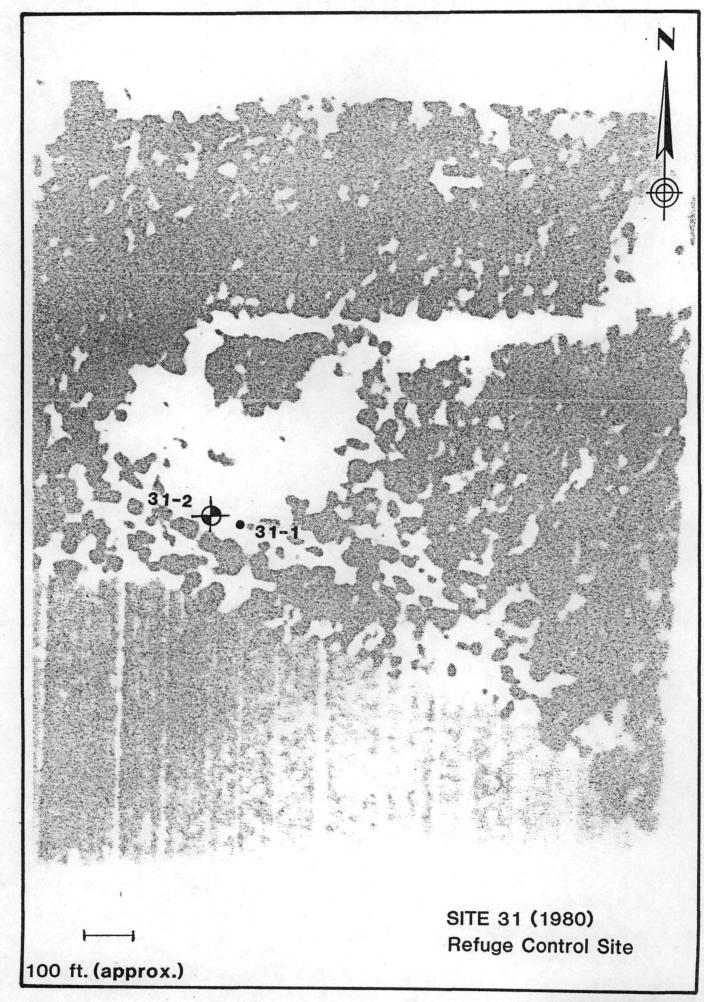
<u>1.D.</u>	Matrix	Name	Type	Depth	Analysis Set
30-1	Soil	Munition Control	Single Sampling	Surface	D
30-2	Water	Munition Control	Single Sampling	Bailer	Α



REFUGE CONTROL SITE

A control sampling station will be established on an uncontaminated area of the refuge. Selection of the control site will be coordinated with the Refuge Manager and the QA/QC advisors. During a site visit to the refuge, an area behind the new refuge headquarters was selected as a control site.

1.D.	<u>Matrix</u>	Name	Туре	Depth	Analysis Set
31-1	Soil	Refuge	Single Sampling	Surface	D
31-2	Water	Control Refuge Control	Single Sampling	Bailer	Α



AREA 9 LANDFILL

Background

The Area 9 Landfill was used during the 1950's and early sixties could approximately closed in 1964. The Landfill is located below the and upflood but of building complex eastern section of Crab Orchard Lake and between the building complex and an intermittent creek. The limits of the landfill are discernable by changes in the topography and vegetation, revealing an area of approximately 2.5 acres with a fill thickness of 8 to 10 feet in the middle and 6 feet at the edges except where waste materials are exposed.

Jone was an void of vegetation.

The volume of the landfill is estimated to be from 16,000 to 35,000 electrical comparison cubic yards. Materials visible at the surface appear to be small considered capacitors, capacitor parts, large chunks of a golden resin, and a large number of 3-inch steel cuplike pieces.

Waste oil and debris were burned, compacted in a swale and in a landfull, covered. Specific compounds of concern include lead, acetate, PCBs (Aroclor 1254 and 1242), and PCB burning products. Other possible materials from capacitor manufacturing include mica, silver, cyanide, aluminum hydroxide, aluminum oxide, gold, copper, zinc, hydrochloric acid, styrene, nitric acid, phosphoric acid, and borates. Other materials may include cyanides, printing inks and lead-based The results of a magnetometer survey indicate a high concentration of metals on the easters side of the landfill.

Sampling and Analysis Schedule

The sampling program for the Area 9 Landfill will consist of:

- 1. Landfill soil cores.
- Surface soils along transect lines along landfill boundaries.
- 3. Soil cores along Intermittent Creek.
- 4. Groundwater Monitoring Wells.

1. Landfill Soil Cores:

The Area 9 landfill has been divided into grids for the collection of soil samples for contaminant analyses. The grid consists of nine sampling sites. Soil cores from the surface to a depth of 12 feet will be collected from three borings (marked x or 0) at each site. Sample collection criteria and chemical substances to be analyzed, in addition to pH, cation exchange capacity, dioxins and dibenzofurans, and explosives residues, are as follows (soil samples will only be composited within and not between locations):

- A. Three, 12-foot deep borings for soil core sample collection will be drilled at each location. One core will be collected from each corner of a 50-ft. triangle at each location.
- B. Soil subsamples will be collected from the upper 6-inches of each core from the three locations on each triangle, composited and analyzed for PCBs, dioxins and furans.

Soil subsamples will be collected at the 6-foot depths of each core from the three locations on each triangle, composited and analyzed for PCBs, dioxins and furans.

Soil subsamples will be collected from the 12-foot depth of each core from the three locations on each triangle, composited and analyzed for PCBs, dioxins and furans.

C. Soil subsamples will be collected at 1-foot intervals from the surface to a depth of 12 feet on each core on each triangle, composited within squares and analyzed for priority pollutants, dioxins and furans and explosives residues.

2. Surface Soils Along Transect Lines:

The exact boundaries of the landfill are unknown because contaminants could have washed from elevated portions of the landfill onto the lower surrounding area. To identify the extent of contaminant transport from the landfill to surrounding areas, surface soil subsamples will be collected at 3-foot intervals along each of the six transect lines, (two each on the east, south and west side of the landfill) and analyzed for PCBs. The transect lines will be at least 30 feet apart. Three additional transect lines may be sampled and analyzed, depending on results from the first six.

3. Soils Cores - Intermittent Creek:

Six soil cores will be collected from the creek east of the Area 9 landfill. Cores will be collected from the surface to a

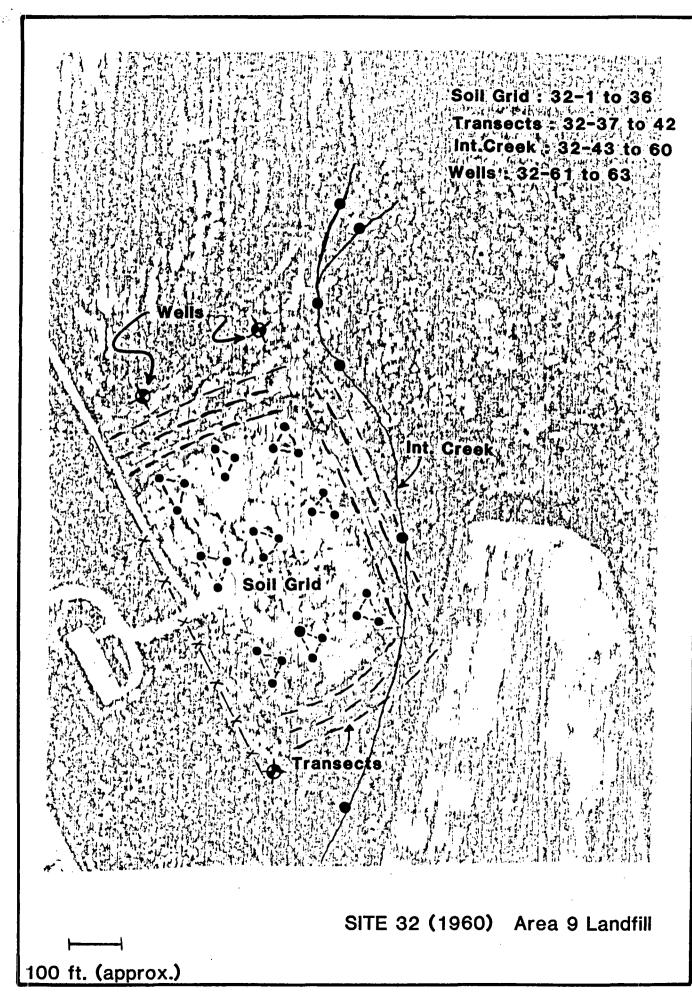
depth of six feet. Individual soil subsamples will be collected from the surface, 3-foot depths and 6-foot depths of each core and analyzed separately for any priority pollutants and/or explosives residues detected above background levels in Area 9 landfill soils.

4. Groundwater Monitoring Wells:

There are three existing groundwater sampling wells in the vicinity of the Area 9 Landfill. Duplicate four-liter groundwater samples will be collected at each well by pumping water directly into labeled acid-cleaned jars after the wells have been flushed. These water samples will be analyzed following EPA approved procedures for priority pollutants, explosives residues and the tetra through octa series of dioxins and debenzofurans. The results of these analyses will be reviewed by the U.S. Fish and Wildlife Service. Additional groundwater sampling wells may be drilled or additional analyses performed if justified by chemical substances detected in the initial analyses or for hydrologic reasons.

<u>I.D.</u>	<u>Matrix</u>	Name	<u>Туре</u>	Depth	<u>Analysis Set</u>
32-1	Soi1	Soil Grid 1	Core Composite at 1/1 depths	0-12 ft.	D
32-2	Soil	Soil Grid 1-0	Top Composite	0-6 in.	С
32-3	Soil	Soil Grid 1-1	Middle Composite	6 -6.5 ft.	С
32-4	Soil	Soil Grid 1-2	Bottom Composite	6-6.5 ft.	С
32-5	Soil	Soil Grid 2	Core Composite at 1' Depths	11/29-12 ft.	D
32-6	Soi1	Soil Grid 2-0	Top Core Composite	0-6 in.	С
32-7	Soil	Soil Grid 2-1	Middle Composite	6-6.5 ft.	С
32-8	Soil	Soil Grid 2-2	Bottom Composite	11.5-12 ft.	С
32-9	Soil	Soil Grid 2-3	Composite at 1' depths	0-12 ft.	D
32-10	Soil	Soil Grid 3-0	Top Core Composite	0-6 in.	С
32-11	Soil	Soil Grid 3-1	Middle Core Composite	6-6.5 ft.	С
32-12	Soil	Soil Grid 3-2	Bottom Core Composite	11.5-12 ft.	С

32-13 Soil Soil Grid 4 Composite at 1' depths 0-12 ft.	D
32-14 Soil Soil Grid 4-0 Top Core Composite 0-6 in.	С
32-15 Soil Soil Grid 4-1 Middle Core Composite 6-6.5 ft.	С
32-16 Soil Soil Grid 4-2 Bottom Core Composite 11.5-12 ft.	С
32-17 Soil Soil Grid 5 Composite at 1' depths 0-12 ft.	D
32-18 Soil Soil Grid 5-0 Top Core Composite 0-6 in.	С
32-19 Soil Soil Grid 5-1 Middle Core Composite 6-6.5 ft.	С
32-20 Soil Soil Grid 5-2 Bottom Core Composite 11.5-12 ft.	С
32-21 Soil Soil Grid 6 Composite at 1' depths 0-12 ft.	D
32-22 Soil Soil Grid 6-0 Top Core Composite 0-6 in.	С
32-23 Soil Soil Grid 6-1 Middle Core Composite 6-6.5 ft.	С
32-24 Soil Soil Grid 6-2 Bottom Core Composite 11.5-12 ft.	С
32-25 Soil Soil Grid 7-0 Composite at 1' depths 0-12 ft.	D
32-26 Soil Soil Grid 7-1 Top Core Composite 0-6 in.	С
32-27 Soil Soil Grid 7-1 Middle Core Composite 6-6.5 ft.	С
32-28 Soil Soil Grid 7-2 Bottom Core Composite 11.5-12 ft.	С
32-29 Soil Soil Grid 8 Composite at 1' depths 0-12 ft.	D
32-30 Soil Soil Grid 8-0 Top Core Composite 0-6 in.	C
32-31 Soil Soil Grid 8-1 Middle Core Composite 6-6.5 ft.	C
32-32 Soil Soil Grid 8-2 Bottom Core Composite 11.5-12 ft.	c
32-33 Soil Soil Grid 9 Composite at 1' depths 0-12 ft.	A
32-34 Soil Soil Grid 9-0 Top Core Composite 0-6 in.	c
32-35 Soil Soil Grid 9-1 Middle Core Composite 6-6.5 ft.	c
32-36 Soil Soil Grid 9-2 Bottom Core Composite 11.5-12 ft.	Č
32-37 Soil W. Transect 1 Composite at 3' Intervals Surface	В
32-38 Soil W. Transect 2 Composite at 3' Intervals Surface	В.
32-39 Soil E. Transect 1 Composite at 3' Intervals Surface	В.
32-40 Soil E. Transect 2 Composite at 3' Intervals Surface	В
	В
32-41 Soil S. Transect 1 Composite at 3' Intervals Surface 32-42 Soil S. Transect 2 Composite at 3' Intervals Surface	В
	A
	A
	Α .
	Α
	A
32-48 Sed. Int. Creek 2-2 Grab 6-foot	A
32-49 Sed. Int. Creek 3-0 Grab Surface	A
32-50 Sed. Int. Creek 3-1 Grab 3-foot	A
32-51 Sed. Int. Creek 3-2 Grab 6-foot	A
32-52 Sed. Int. Creek 4-0 Grab Surface	A
32-53 Sed. Int. Creek 4-1 Grab 3-foot	A
32-54 Sed. Int. Creek 4-2 Grab 6-foot	A
32-55 Sed. Int. Creek 5-0 Grab Surface	A
32-56 Sed. Int. Creek 5-1 Grab 3-foot	A
32-57 Sed. Int. Creek 5-2 Grab 6-foot	A
32-58 Sed. Int. Creek 6-0 Grab Surface	D
32-59 Sed. Int. Creek 6-1 Grab 3-foot	D
32-60 Sed. Int. Creek 6-2 Grab 6-foot	D
32-61 Water Well 1 Single Sampling Bailer	A
32-62 Water Well 2 Single Sampling Bailer	Α
32-63 Water Well 3 Single Sampling Bailer	Α



AREA 9 BUILDING COMPLEX

Background

The Area 9 Building Complex was leased during the period from 1946 to 1962 as the Ordill Facility containing the Sangamo Capacitor Division. Manufacturing operations began in the early 1950's. This division manufactured power factor capacitors, AC motor run capacitors, and a variety of DC capacitors. The components were of various types and included aluminum, electrolytes, mica, and silver and lead foil. The Division also manufactured small transformers that used mineral oil as a dielectric.

Subsequently, Olin Corporation started using the industrial facilities at the site. Olin manufactured explosives that were used to start jet engines. The company used nitro-glycerine in its operation.

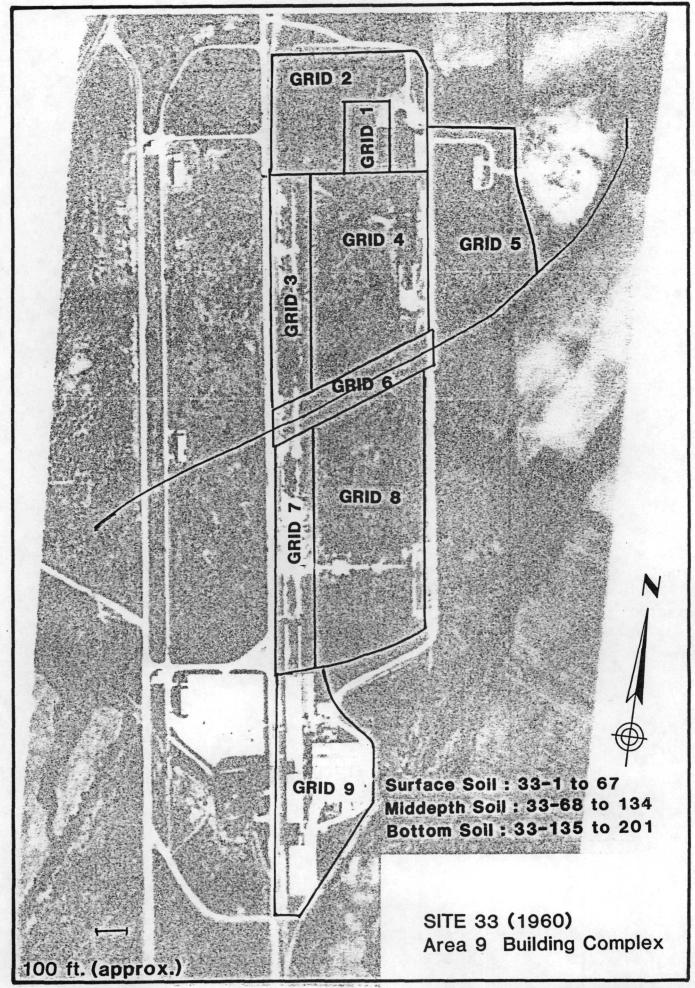
Sampling and Analysis Sequence

Soil cores will be collected from the surface to a depth of 4-feet at attacked photo.

Sites shown on Figure 4: Sampling sites will be selected within nine separage grids on the plant property. Sampling locations will emphasize areas of drainage pathways, proximity to buildings, and transportation routes during solid waste disposal. In addition, the sampling locations will be developed using analytical data previously obtained for this site.

The surface soils of each core will be first analyzed for PCBs. If PCBs are detected in surface soils of core, analyses will be performed on a soil sample from mid-depth and the bottom of the core.

1.D.	Matrix	Name	Туре	Depth	Analysis Set
33-1		Soil Core 1			_
to 67	Soil	to 67	Core Surface	0-6 in.	В
33-68		Soil Core 1			
to 154	Soil	to 67	Core Mid-Depth	2-2.5 ft.	В
33-135		Soil Core 1			
to 201	Soil	to 67	Core Bottom	3.5-4 ft.	В



The Road detak will be sampled as well any other area that receives) drainings from the ditches.

CRAB ORCHARD LAKE

Background

(completed in 1940)

Crab Orchard Lake has a surface area of 6,965 acres, a maximum depth of 30 feet, and 635 acre-feet of storage capacity. The watershed drainage area is 109,261 acres. The lake has a retention time of approximately 0.8 years. Water enters the lake through several creeks, including Crab Orchard Creek on the eastern end of the lake and an intermittent creek adjacent to the Area-9 Landfill. Water leaves the lake through Crab Orchard Creek on the western end of the lake. In addition, 280,000 gallons/day of water is used by the Refuge.

The eastern section of the lake is near several manufacturing operations established since the 1940s.

Sampling and Analysis Schedule

Sediment, water, fish, turtles and crayfish will be collected from the lake as follows. The parameters for analysis will be selected on the basis of parameters identified at the study sites on the Refuge.

1. Sediment

Sediments will be collected from nine sites on Crab Orchard Lake.

Samples will be collected using an acetone rinsed dredge or, in shallow water, by scooping the sediments directly into the containers. Sediment samples will be stored in labeled, acid-cleaned jars. A sample will consist of a one-liter jar and three 40 ml septum vials of sediment collected from the same

Or complete analyses of H2O can't be completed during Phase I, because H2O is to be analyzed for Contaminants detected in terrestial sites.

It's best to collect fresh H2O eamples for analysis after analysis have been cidentified, Therefore, collecting water camples and stowing them, H2O will be collected from phase IL, samples

location. The samples in the septum vials will be analyzed for volatile organics. The one-liter sample will be analyzed for priority pollutants other than volatile organics.

2. Water

Water samples will be collected from the same locations as sediment samples for the Phase II sampling and analysis. However, four water samples will be analyzed during Phase I for drinking water quality parameters. and RCB^{S} .

3. Fish

required for analyses to adequately assess human health impacts

fish samples will be collected from the substitute of the following figure. The number of samples required for analyses to adequately assess human health impacts

from contaminants will be compatible with Illinois Department of

Public Health requirements.

Carp and largemouth bass will be collected at each lake and control station. If these species are not available at a station, a species that is available may be substituted. The largest fish collected will be used for analyses. Fish will be analyzed as composite samples. A composite sample will consist of five fish of the same species. One composite samples of each species will be collected at each station. The composited samples will be analyzed on a whole-fish basis. The western end of the lake will be used that as a control.

of high levels of contaminants

4. Crayfish

Crayfish will be collected in minnow traps baited with chicken by FWS proposed, parts. Crayfish will be collected from the fish sampling locations.

Crayfish may not be present in the deeper water of the mid-lake fish sampling stations. In this case, crayfish will be captured from the shoreline closest to the fish sampling area. A composite crayfish sample will weigh 300 grams or more. Crayfish will be and placed in labeled Whirl-pak bags and frozen before being shipped in ford quality bags, to the analytical laboratory. Crayfish will be analyzed whole-body.

5. Turtles

Snapping turtles will be collected from Crab Orchard Lake using liver baited treble hooks on a trot line. Two or more turtles will be collected from each of the fish sampling locations. It may not be possible to collect turtles from all locations. Turtles will be labeled and frozen whole before being shipped to the analytical laboratory.

Turtle livers and fat will be removed at the laboratory and analyzed separately using EPA approved procedures.

On the following schedule, samples 34-1 through 34-5 will be calleted and sampled and analyzed during Phase I. All remaining samples will be analyzed as a part of Phase I.

	<u>I.D.</u>	Matrix	Name	<u>Type</u>	<u>Depth</u>	Analysis Set
	34-1	Water	Refuge Intake	Grab	NA	E
	34-2	Water	Marion Intake	Grab	NA	Ε
	34-3	Water	Marion Res Intake	Grab	NA	E
	34-4	Water	Refuge Finished Water	Grab	NA	E
	34-5	Water	Marion Finished Water	Grab	NA	E
	34-6 to 15	Water	Lake 1 to 10	Composite of 3 depths	Surface to 0.8 depth	A*
	34-16 to 20	Sediment	Lake 1 to 10	Grab	Dredge	A*
	34-21 to 30	Fi sh	Lake 1 to 5	Composite of Samples	N/A·	A*
and f	34-31 to 33	Turtles	Lake 1 to 5	Single Sampling	Bottom	A*
	34-34 to 36	Crayfish	Lake 1 to 3	Composite of 300 gms	Surface	A*
Fintak	*Only the	depth,	ors found at conce O Sample and but	entrations of significance, will be ta	e at any other s her from orte n	ite.

APPENDIX IV

WORK PLAN SCHEDULE

CRAB ORCHARD NATIONAL WILDLIFE REFUGE MODEL WORK PLAN SCHEDULE

TASK DESCRIPTION						-									T	M	E (M	NC	T۲	IS:)																				
1 DESCRIPTION OF CURRENT SITUATION	0	1	2		3	4	. 5 		6	7		8	9					12							17	18		19	20	21	_		23		· 25		-	27	28	_		30
1A SITE BACKGROUND	- 2 22	8 .	·		Ċ																																					
19 NATURE AND EXTENT OF PROBLEM			•		•	•																													•					• •	•	
1C HISTORY OF RESPONSE ACTIONS 10 REVIEW OF PREVIOUS INVESTIGATIONS		• •	•	• •	•	: .	•	•		•	•		-	-		•	-		•			-		-							-			-							:	
1* REMEDIAL INVESTIGATION WORK PLAN			·																											_	-				-							
O DEMENSAL INFECTICATION CHOROUT		• •			•	•				-								-	•											-					•							
2 REMEDIAL INVESTIGATION SUPPORT 2* SUBCONTRACTOR PROCUREMENT		- =	1.		•	• •	•	•	• •																																	
2A SITE VISIT								·		•									-											-												
28 SITE MAPS			•		•	• •		•		•	•		•			-			-											-	-				•							
2C DISPOSE DN-SITE GENERATED WASTES 2* SITE OFFICE	11																																		•							
	XXX																																									
3 SITE INVESTIGATIONS									-										-											-												
3* WASTE CHARACTERIZATION 3A GEOPHYSICAL SURVEYS		• •	-							-	-					-					-									-	-				•							
38 HYDROGEOLOGIC INVESTIGATIONS			·																											-					•							
3C SAMPLING & ANALYSIS OF GROUNDWATER		· į							4	1		1		F 100				_			•														•							
3D SOILS INVESTIGATIONS 3E SURFACE WATER & SEDIMENT INVESTIGATION														~~ ~						_	_														•							
3F FISH & WILDLIFE INVESTIGATIONS		-	-						-	-	-	-				-			-		-		-	-											-			-				
A DOCUMENTAL SCHOOL STATE																																										
4 PRELIMINARY REMEDIAL TECHNOLOGIES 4* PRE-INVESTIGATION EVALUATION																																										
4A POST-INVESTIGATION EVALUATION																																										
E STE THURSTONTIBUS ANALYSES		• •	•		•			•																						-					•							
5 SITE INVESTIGATIONS ANALYSIS 5A DATA ANALYSIS & ENDAGERMENT ASSESS.		: :	•																																•							
5* APPLICATION OF PRELIMINARY TECHNOLOGIES																																										
6 REMEDIAL INVESTIGATION REPORT			•				•																												•							
a RENEWIAL INVESTIGATION REFORT																																										
7 COMMUNITY RELATIONS			•		•		•	•		•						•			•			•		•		•		•		•			•								•	
8 ADDITIONAL REQUIREMENTS									-																					_												- - TC
8A REPORTING REQUIREMENTS	,0000	ماعماد		1000							مامم		أإصماد		000			100				عصف	2001		واووا		فافاها							000	اماماما	0000	(0)06	1000	عقامة	100	000	
8B SAFETY PLAN 8C QUALITY ASSURANCE/QUALITY CONTROL	·1 =	1 .	•																																							
oc World Hospithans Agusti Coultage	XXXX	5	:	<i>.</i> .																																						
9 DESCRIPTION OF PROPOSED RESPONSE																											_		_													
10 DEVELOPMENTS OF ALTERNATIVES		• •																																								
10A ESTABLISH. REMEDIAL RESPONSE OBJECTIVES																																										
10B IDENTIFICATION OF REMEDIAL ALTERNATIVES										•									•			•					88	**	۶.	50					•			, <u>.</u>	•			
11 INITIAL SCREENING OF ALTERNATIVES	• •		•	• •	•		•	•	•	•																			_										• •	•	•	
11 Indiana South Indiana St. Indiana 1725	: :	: :	:	: :																																	: :					
12 LABORATORY STUDIES (OPTIONAL)			•							٠	٠.		•			•			•			٠				•				•			•				٠.		•		•	
13 EVALUATION OF ALTERNATIVES			•	• •	•	•	•	•	• •	•	•	•	•	• •	•	•	• •	•	•	• •								-		•			•				•		• •	•	•	
13B ENVIRONMENTAL ASSESSMENT			•		•		•	•		•	٠.			٠.	•	•																	•		•			•	•		•	
13C COST ANALYSIS 13D EVALUATE COST EFFECTIVE ALTERNATIVE			•		•	• •	•	•		:	• •	•	•	• •	•	•		•	•									_		:			8 I. .	 61 =					: .		:	
13E PRELIMINARY REPORT																																×	11.		Χ̈́	₹.						
14 CTUR DEPORT											٠.					٠										•				Ŧ			•					•		٠.	•	
14 FIMAL REPORT		•																																	 XXX					1 =		i
15 CONCEPTUAL DESIGN																																			XXX				. I	. 1	<u>.</u>	1
// ADDITIONAL REQUIREMENTS			•					•		•			•																	•			**	XXX	**				•	<u>.</u>	•	_
16 ADDITIONAL REQUIREMENTS	• • •	• •	•	• •	•		•	•	• •	•	٠.	•	•	• •	•	•	• •	•	•	• •	•	•		•	• •					اوهود	000		احقام		عادماد			المماد				ı

LEGEND

TOTAL REFUGE RI/FS

AREA 9 RI/FS

DELIVERABLES

REMEDIAL INVESTIGATION AND FEASIBILITY STUDIES

MODEL WORK PLAN SCHEDULE

Estimated Personnel

Completion

		Task No.	Task	Output	Cost	Work Hours	Date
4 11		1.	Description of Current Situation	Draft Final Report Section			
		1a.	Site Background				
49 (4		1b.	Mature and Extent of Problems				
m ié	lagg p.€	1c.	History of Response Actions				
		2.	Investigation Support	Draft Final Report Section			
		2ā.	Contractor Procurement	RFP (or IFB)			
		2b.	Site Visit				
w ill-		20.	Site Maps including a visual and description of the site boundaries of contaminated areas	Maps and Text			
44/8		3.	Site Investigations	Investigations, Draft Final Report Section			
A ni	's mare'	3a.	Geophysical Surveys				
e i na		3b.	Hydrogeologic Investigations				
411		Зс.	Soils and Sediment Investigations				
01		4.	Preliminary Remedial Technologies				
		5.	Site Investigations Analyses	Draft Final Reports			
I} ++ •₫		5a.	Data Analyses				
G H Z		5b.	Application to Preliminary Technologies				
404		6.,	Final Report	Final Reports			

REMEDIAL INVESTIGATION AND FEASIBILITY STUDIES

MODEL WORK PLAN SCHEDULE (Continued)

- 10	Task No.	<u>Task</u>	Output	Estimated Cost	Personnel Work Hours	Completion Date
-	7.	Community Relations	Site Health and Safety Plan and Quality Assurance Project Plan			
40 4	8.	Additional Requirements				
10 to 1000 to 1 ¹⁷	9.	Description of Proposed Response				
mille (all	10.	Development of Alternatives	Preliminary Alternatives Submitted, Draft Final Report Section			
	10a.	Response Objectives				
⊕ -4	10b.	Identification of Remedial Alternatives		,		
4 11	11.	Initial Screening of Alternatives	Draft Final Report Section			
	11a.	Laboratory Studies (Optional)				
Elo ng (A ^{pr} Hills	12.	Evaluation of Alternatives	Preliminary Final			
41 I JB	13a.	Detailed Development of Remaining Alternatives				
11 1 1/1	13b.	Environmental Assessment	Environmental Information Document			
	13c.	Cost Analyses				
	13d.	Evaluation and Recom- mendation of Cost - Effective Alternatives				
	13c.	Preliminary Report	Preliminary Report			
6 1 + 2 0	14.	Conceptual Design	Draft Final Report Section			

REMEDIAL INVESTIGATION AND FEASIBILITY STUDIES

MODEL WORK PLAN SCHEDULE (Continued)

an u	Task No.	<u>Task</u>	Output	Estimated Cost	Personnel Work Hours	Completion Date
	15.	Final Reports	Final Reports			
-	16.	Additional Requirements				
44 11						